Tips, tricks & solutions for cell culture, molecular biology & liquid chromatography

A guide to troubleshooting water problems in laboratory experiments

Contents

Introduction

There are a number of reasons things may not go according to plan during your research. In addition to factors such as equipment breakdown, reagent supply issues and (even) human error, you'll also have multiple sources of contamination to contend with. Here we focus on the contaminants that can be found in your laboratory water supply and provide insights as to how you can prevent these from compromising experimental procedures, data analyses and downstream applications.

Water is perhaps the most prevalent reagent used in the lab, with the average laboratory building using an estimated 35 million liters per year. That's almost five times more than a similarly sized office building![1,2] As such, it is important to control, maintain and monitor water purity very carefully in your laboratory.

Water contamination can cause a number of problems leading to you losing your samples and even damage to products, while the untimely discovery of contamination could call into question the accuracy and validity of your data. If that wasn't bad enough, the amount of time, resources and money required to remedy these issues can be significant, distracting you and other members of your laboratory from focusing on your true pursuit – scientific discovery.

Several different factors can contaminate your laboratory water supply. These include bacteria and their by-products (i.e. endotoxins) as well as other microorganisms and biomolecules, ions, dissolved gases, inorganic and organic compounds, particles and degradative enzymes (e.g. nucleases and proteases).

Here we provide an overview of the best methods for preventing contamination in common laboratory applications. This includes a summary of the good laboratory practice (GLP) guidelines, as well as the different processes involved in water purification. The focus will be on troubleshooting water problems in particularly sensitive applications, such as cell culture, molecular biology and liquid chromatography, where water purity is of particular importance. In each case, we provide a summary of the causes, problems and troubleshooting tips for each.

General tips for preventing water contamination

We recommend you adhere to Good Laboratory Practice (GLP) guidelines throughout any experimental procedure to ensure the consistency, reliability, reproducibility, quality and integrity of your research. As discussed later in this document, a number of experimental errors can arise if you use water of poor quality or inadequate purity. Here's a brief summary of the various methods by which you can remove contaminants from your water supply or preventing them from entering the system in the first place.

Good laboratory practice

GLP[3] is defined as,

"A quality system concerned with the organisational process and the conditions under which non-clinical health and environmental safety studies are planned, performed, monitored, recorded, archived and reported."

GLP is a must in many industrial labs. While it is not adhered to quite as strongly in academic labs, many of the principles form the underlying basis of carrying out effective research. A clearly defined set of laboratory procedures can aid you in reducing the chance of contamination and error. These should include protocols and schedules for cleaning your laboratory as well as details of designated areas and equipment (e.g. pre-PCR vs. post-PCR). In addition, these should also highlight the importance of wearing the correct personal protective equipment (PPE) including lab coats and gloves, and keeping up-to-date records of information such as batch numbers, to help identify the source of the problem and prevent it in future. You should carry out regular maintenance and testing of all your systems to help prevent accidents, while everyone in the lab should be fully trained and follow Standard Operating Procedures (SOPs) for experiments, maintenance and cleaning.

"It is important to ensure that the water purity you use is suitable for your application"

How lab water is typically purified

GLP will go a long way towards preventing contamination in your lab. However, in order to further protect your experiments, it may help to know how the various water purification methods work and the types of impurities they remove. This will aid in ensuring you have the correct purification systems in place to achieve adequate water purity for the task at hand. We recommend you use a combination of water purification methods. These can include reverse osmosis (RO), ion-exchange (IX) resins, electrodeionization (EDI), ultraviolet (UV) light and ultrafiltration. Details on each of these can be found in our free whitepaper, entitled *'Water: The Essence of the Lab'* (download it now for more information).

Choosing the right water purity for your application

Some experiments are more sensitive to contamination and may require a higher grade of water quality.

Hence, it is important to ensure that the water purity you use is suitable for your application. Water purity ranges from Type I+, which has a resistivity of 18.2 MΩ-cm and is used in highly sensitive experiments, to Type III, which has a resistivity of >0.05 MΩ-cm and is used as feedwater for purification systems, as well as washing machines and autoclaves. To help, we've listed further details of the various water grades in Table 1.

Grade of water	Resistivity (MΩ-cm)	TOC (ppb)	Bacteria (CFU/ml)	Endotoxin (EU/ml)
Type I+	18.2	<5	<1	<0.03
Type I	>18	<10	<10	<0.03
Type II+	>10	<50	<10	NA
Type II	>1	<50	<100	NA
Type III	>0.05	<200	<1000	NA

Table 1: Details of various water grades and typical applications. TOC, total organic carbon; ppb, parts per billion; CFU, colony forming units; EU, endotoxin units.

Access to water of a consistent quality is essential in the lab. Therefore, you'll need a system that not only purifies the water, but also monitors contaminant levels to ensure you get the desired water quality each and every time. It is also important to perform regular maintenance of water purification systems and consider carefully how your newly purified water will be stored. This is because some storage containers can leach contaminants back into the water over time and the amount of gas dissolved in water can change as it settles.

The PURELAB® Chorus range from ELGA allows you to select a purification solution to meet the specific requirements of your laboratory. This allows you to match the correct water quality with the needs of your application. This will save you time (as you won't need to repeat any experiments having used the wrong water quality). It also helps to ensure that you don't waste energy, resources and funds (e.g. using Type I+ water when Type III would suffice).

Water troubleshooting for sensitive applications

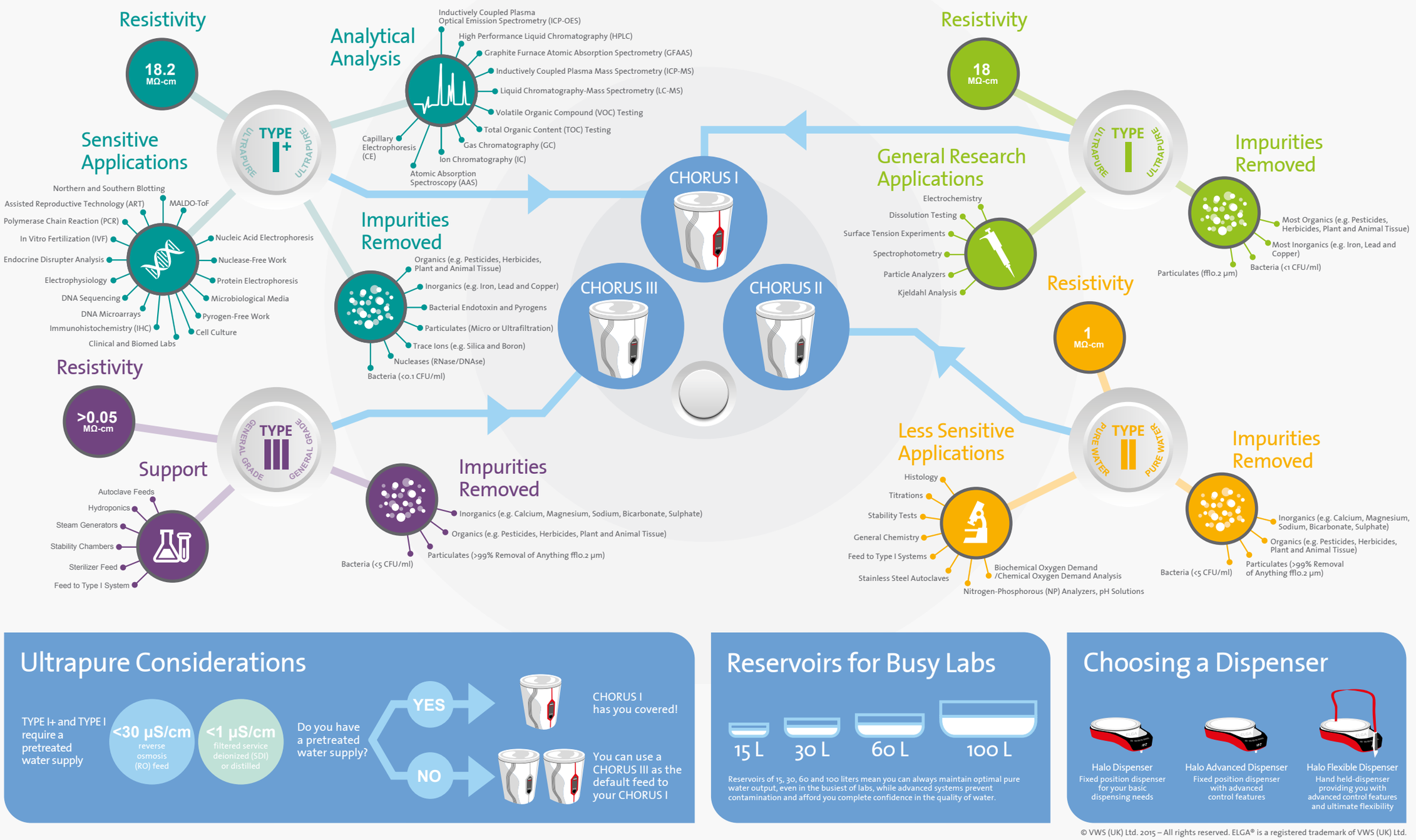
If you stick to the GLP guidelines, use the correct water purity for your application and carry out frequent maintenance of your purification system, you will significantly reduce the risk of contamination occurring. However, some applications are more sensitive (Figure 3) and require an enhanced level of vigilance.

To help, we've provided a troubleshooting guide for three common laboratory procedures; cell culture, molecular biology and liquid chromatography. This includes suggestions on how to identify which types of water impurities may be responsible and solve common problems when carrying out your experiments.

Harmonious water purification

Match your application with water type and let your data sing

ELGA VEOLIA



Ultrapure Considerations

TYPE I+ and TYPE I require a pretreated water supply

<30 µS/cm reverse osmosis (RO) feed

<1 µS/cm filtered service deionized (SDI) or distilled

Do you have a pretreated water supply?

YES — CHORUS I has you covered!

NO — You can use a CHORUS III as the default feed to your CHORUS I

Reservoirs for Busy Labs

15 L 30 L 60 L 100 L

Reservoirs of 15, 30, 60 and 100 liters mean you can always maintain optimal pure water output, even in the busiest of labs, while advanced systems prevent contamination and afford you complete confidence in the quality of water.

Choosing a Dispenser

Halo Dispenser
Fixed position dispenser for your basic dispensing needs

Halo Advanced Dispenser
Fixed position dispenser with advanced control features

Halo Flexible Dispenser
Hand held-dispenser providing you with advanced control features and ultimate flexibility

Figure 3: Various laboratory techniques and the water purity levels required in order to prevent contamination and collect high quality data.

Liquid chromatography (Problems, causes & troubleshooting)

Liquid chromatography is a technique used to separate and identify the constituent components of a sample. The sample of interest is mixed with the mobile phase (often containing water, methanol and/or acetonitrile) and passed along a column. Each component will flow through at a different rate due to varying degrees of interaction with the adsorbent stationary phase, allowing the composition of the sample to be determined.

The various types of chromatography systems used in the laboratory include ultra-high performance liquid chromatography (UHPLC) and high performance liquid chromatography (HPLC), which pump a pressurized mobile phase through the column. This can also be combined with a mass spectrometer for downstream molecular analysis of the component factors.

Chromatography is highly sensitive. As such, it is capable of differentiating between ionic forms of the same analyte. However, this sensitivity can come at a price – it is essential that you ensure that the mobile phase is free from contaminants, which might otherwise compromise your results and damage your equipment.

Electrical issues, temperature, leaky injectors and pump failure are just some of the factors that can affect your progress. Here we focus on the problems that can occur if low quality water is used, including variable retention times, loss of resolution, tailing peaks, baseline drift, noisy baselines, negative peaks, ghost peaks, adduct peaks and back-pressure. In each case, we provide illustrated examples of what your data might look like, to help you troubleshoot water issues within your chromatography experiments.

Problems

Variable retention times

Small changes in the mobile phase caused by water contaminants or non-homogenous mobile phase can lead to a shift in retention times (Figure 4).

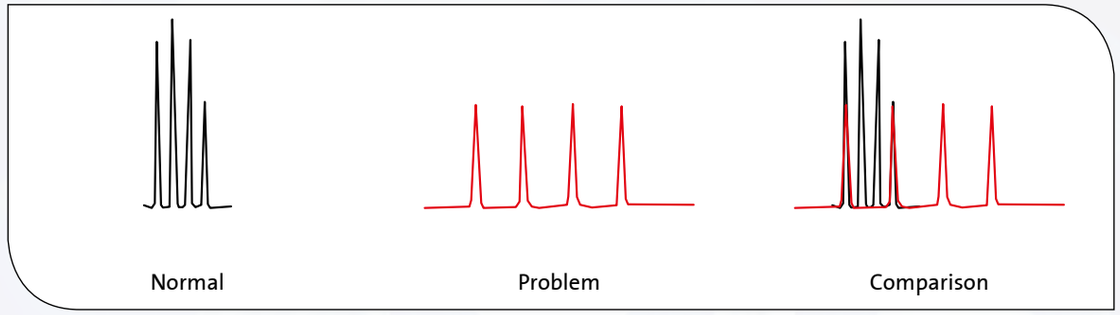


Figure 4: Illustrated chromatogram showing variable retention times.

Loss of resolution

If your mobile phase is contaminated or deteriorated, this can lead to a change in retention times or selectivity and ultimately a loss of resolution (Figure 5). This can make it difficult for you to identify sample components.

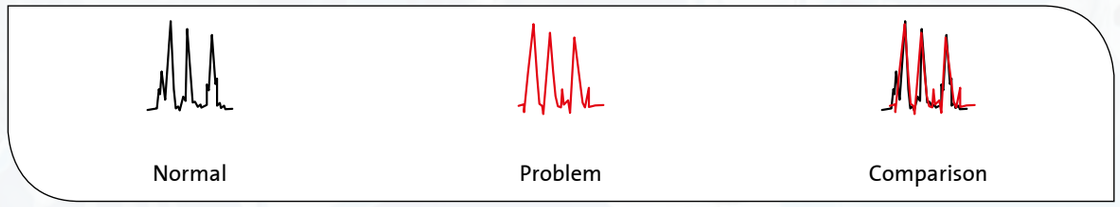


Figure 5: Illustrated chromatogram showing a loss of resolution.

Tailing peaks

If your mobile phase is contaminated this can lead to tailing peaks (Figure 6).

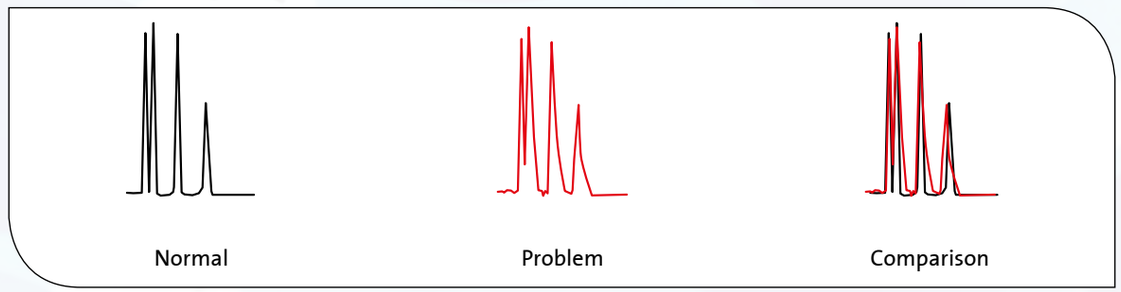


Figure 6: Chromatogram showing tailing peaks.

Baseline drift

The baseline may appear to be rising (Figure 7) if your mobile phase is not completely homogenized. This can also occur if you have stored it for an extended period or used low quality water and/or non-HPLC grade reagents to prepare it.

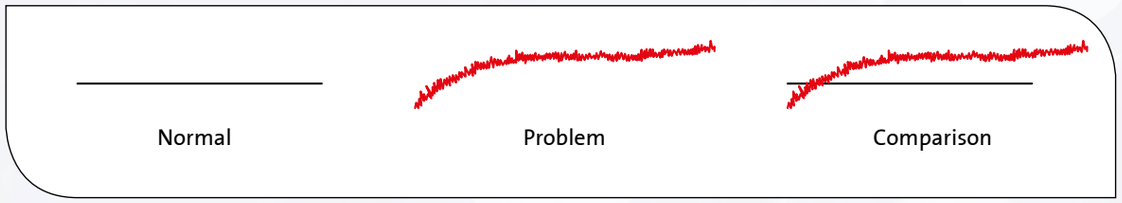


Figure 7: Chromatogram showing a drifting baseline.

Noisy baseline

Noisy baselines (Figure 8) can appear in the chromatogram if the reagents or water used to prepare your mobile phase are not HPLC-grade. As a result, your mobile phase will deteriorate and contaminants will elute off of the column.

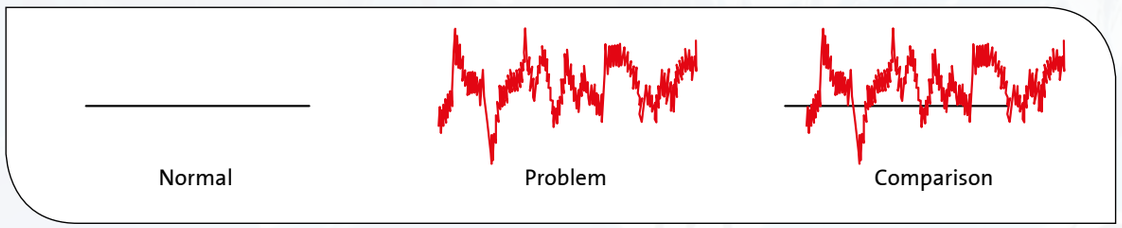


Figure 8: Chromatogram showing a noisy baseline.

Negative peaks

If your mobile phase is more absorptive than the sample components, this can present as negative peaks (Figure 9).

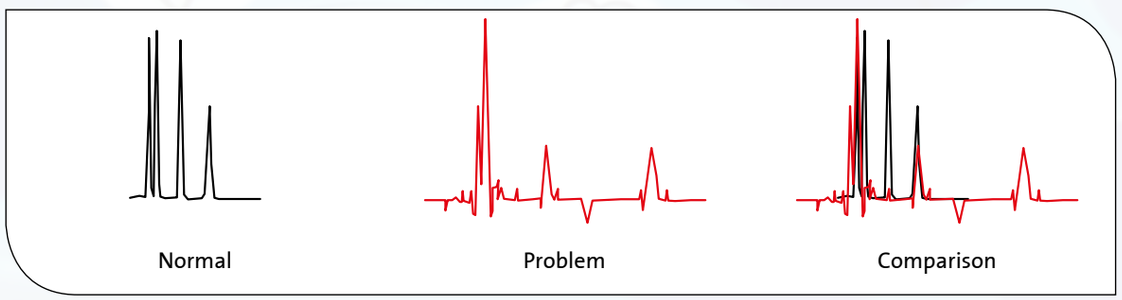


Figure 9: Chromatogram showing negative peaks.

Ghost peaks

Spurious peaks may develop if contaminants are absorbed onto the column. In order to differentiate between true sample readouts and ghost peaks (Figure 10), you should run a blank to determine which peaks are due to contamination.

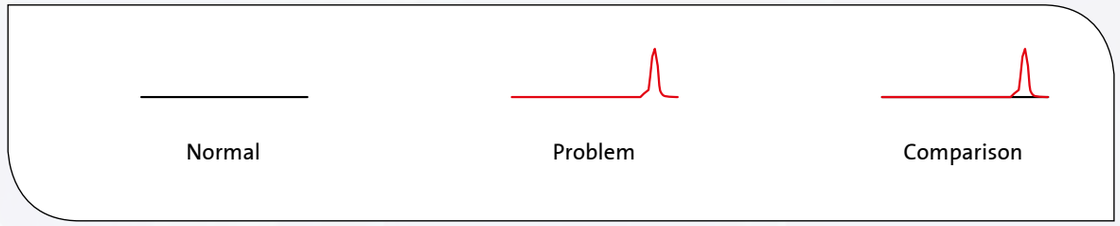


Figure 10: Chromatogram showing ghost peaks.

Adduct peaks

Adduct peaks (Figure 11) are mainly a problem when carrying out mass spectrometry and occur when contaminating ions alter the ionic strength of the sample components.

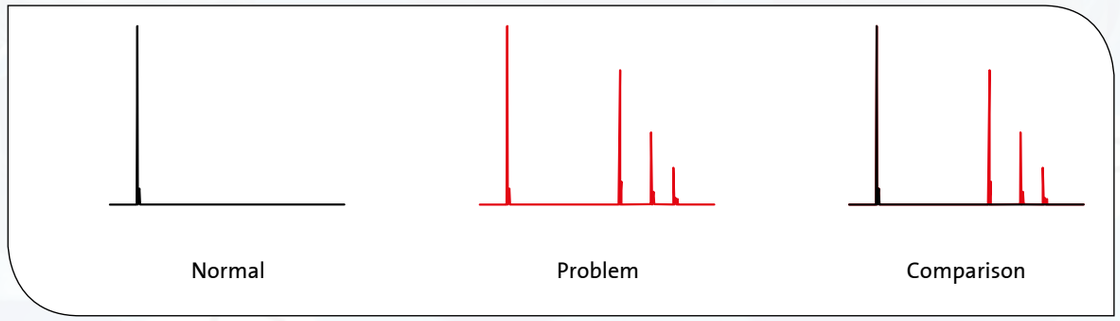


Figure 11: Chromatogram showing adduct peaks.

Back-pressure

Back-pressure occurs due to a build-up of contaminants in the system. If this persists, it can cause columns to fail or explode and ultimately shorten column life and lead to system shutdown.

Causes

Water is used in liquid chromatography to prepare the mobile phase, samples, standards and blanks as well as clean containers. Contaminants in water such as organics, ions, particulates and bacteria may lead to poor quality data.

Furthermore, system components can get coated with impurities and lead to filters introducing particulates. Opposite are a list of contaminants you should be wary of (and the types of problems they can cause).

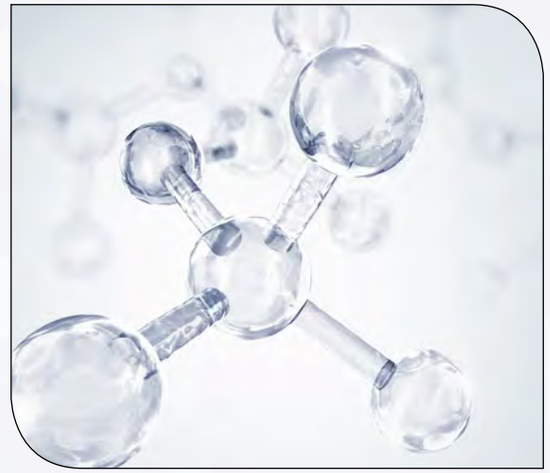
Organics

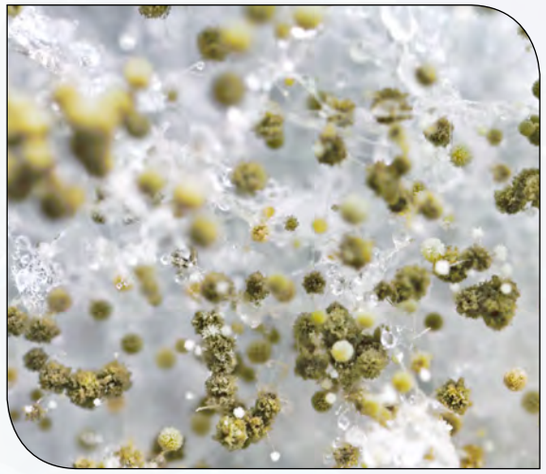
If organic contaminants are present in your mobile phase, these can accumulate on the column head. These may then be eluted and present as ghost peaks in the chromatogram. Organics can also act like the stationary phase, causing a shift in retention times and peak tailing.

A reduction in resolution and sensitivity as well as baseline noise and drift are also evidence of organic impurities in your chromatography system. Furthermore, organic accumulations can lead to column back-pressure and subsequently damage the column.

Ions

Ions such as sodium (Na), potassium (K), aluminum (Al), calcium (Ca), iron (Fe), magnesium (Mg), copper (Cu) and platinum (Pt) can modify the ionic strength of the analyte in your mobile phase. This is mostly a problem for mass spectrometry-associated chromatography systems.



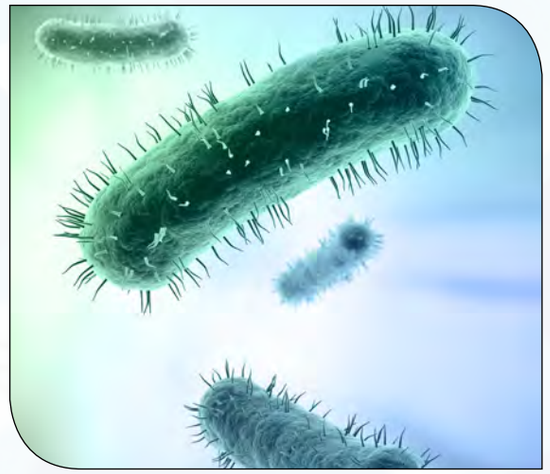


Bacteria

The aqueous mobile phase is susceptible to microbial growth. Should bacterial by-products (e.g. cell walls) enter the system, these will behave as particles, plugging the pump and leading to a build-up of pressure in the column. This can not only damage your chromatography equipment, but also result in poor quality data due to an increase in background absorbance.

Particulates

If you use poor quality water or non-HPLC reagents to prepare the mobile phase, this can introduce particulates, which in turn will appear as a noisy baseline in the readout. The build-up of particulates can also lead to an increase in system back-pressure due to column plugging. Consequently, this could cause columns to explode and damage the HPLC pump and injector.



Troubleshooting

In order to prolong the life of your chromatography systems and ensure optimal data accuracy, you should use ultrapure Type I+ water throughout the process. This is particularly important when preparing the mobile phase, which should only ever include HPLC-grade reagents (e.g. acetonitrile) and water. If a reagent does become contaminated at any point, or is out of date, you should discard the batch. It is also important to ensure you homogenize your mobile phase thoroughly.

Using freshly prepared water from an in-house filter system will reduce the chance of contamination, as this is more likely to occur when using water that has been stored for an extended period. That being said, you should change water filters regularly to prevent contaminants from building up and being released. We'd also recommend that you discard the first couple of liters when collecting freshly prepared ultrapure water for chromatography, as this will reduce the risk of any filter contaminants entering the system.

Ultrapure water is an excellent solvent and will leach contaminants from containers. For this reason, you should also avoid using plastic tubing and storage containers, as phthalates can leach into the water supply. We recommend only ever using dedicated glassware to store your water. Even though this may still release ions into solution, you can reduce the risk of contamination by cleaning glassware properly. This means you should only wash and rinse glassware with mobile phase solvents and ultrapure water. If more rigorous cleaning is required, sonicate with 10% formic acid or nitric acid, then water, then methanol or acetonitrile and then water again (repeating this process twice or more, as necessary). Don't use detergents, as residues (e.g. polyethylene glycol) can be detrimental to experiments. Once clean, nothing should touch the internal surface other than the solvent i.e. don't dry glassware on racks and make sure it is washed and stored separately from glassware that is used for other experimental procedures.

Ultrapure water will also absorb contaminants from the atmosphere. Therefore, in order to prevent bacteria from entering the system, you should prepare, de-gas and filter (0.2µm or 0.45µm) your mobile phase daily. After long periods of shutdown, you should flush water and the appropriate organic solvent (e.g. acetonitrile or methanol) through the system. Storing the system in water may also result in microbial contamination. If your chromatography system does become contaminated with bacteria, you should autoclave all containers as well as replace the filters and tubing. We'd also suggest you purge the system in methanol or acetonitrile overnight.

Liquid chromatography checklist

- ✔ Use ultrapure Type I+ water
- ✔ Prevent atmospheric contaminants entering
- ✔ Don't store reagents for extended periods
- ✔ Use HPLC-grade reagents
- ✔ Homogenize mobile phase
- ✔ Ensure mobile phase is not absorbed
- ✔ Use appropriate glassware cleaning methods
- ✔ Change chromatography system filters regularly
- ✔ Use point-of-use filter water rather than bottled/stored
- ✔ Change consumables

"system components can get coated with impurities and lead to filters introducing particulates"

Cell culture (Problems, causes & troubleshooting)

Cell culture involves culturing cells outside of their natural environment under a set of controlled conditions. In addition, all work is carried using aseptic techniques in a sterile laminar flow hood. If any impurities do manage to enter your cultures, this could result in a number of unwanted side effects, including poor cell growth, cell death and potentially lead to inaccurate data.

Water is used at numerous stages throughout the culture process. This includes the preparation of media and wash solutions, as well as cleaning glassware. Water is also involved in less direct ways, for example, when bringing solutions up to temperature in water baths and can also be found in the incubator reservoir.

Here are some of the problems that can occur in the cell culture laboratory if your water becomes contaminated, as well as some steps you can take to reduce the risk of this happening.

Problems and causes

Poor cell growth or cell death

One of the most common problems that can occur in cell culture is poor cell growth or cell death. This can ruin months of work and delay your progress, as well as lead to the generation of erroneous data. This can be a particular challenge if your experiment involves triggering and measuring a decrease in viability. There are a number of impurities commonly found in water that can hinder cell growth, including endotoxins, metal ions and other impurities.

Metal ions and impurities

Metal ions can be found in the water used to make media and wash glassware. Highly-purified water is also an aggressive solvent and can leach toxic metal ions from glassware, pipettes/tips and plasticizers from plastics tubing or vessels. Furthermore, the steam in autoclaves often contains additives to reduce scale build-up (which could ultimately end up on your glassware, before leaching into your culture).

Endotoxins

Endotoxins are pyrogens found in the outer membrane of Gram-negative bacteria. They can enter cell cultures through water, sera and other culture additives. Endotoxins can elicit a strong immune response and are highly biologically reactive. Accordingly, they can affect culture growth and lead to experimental variability so, if you do suspect contamination, you should conduct a limulus amebocyte lysate (LAL) assay.

Contaminated cultures

Contaminants such as bacteria, molds, yeasts and fungi can all enter cell cultures via water. Some of these are easy to notice with the naked eye. However, some can remain undetected even when examined under the microscope. Therefore, we recommend you monitor your cultures regularly.

Bacteria, molds and yeasts

Biological contaminants are found everywhere, including water. Once these enter your cell culture this provides optimum growth conditions and the problems they cause can quickly escalate. This often leads to changes in turbidity or pH. The latter will alter the color of the culture from red to yellow (if your media contains a phenol red indicator). However, not all changes are easily noticeable. Some, such as mycoplasma contamination, can be difficult to detect, especially if the contaminating organisms are slow growing.

Spore generating fungi

In many labs, water baths are used to defrost cell culture reagents, such as sera, or bring media up to temperature before adding them to the cells. Water in the incubator tray helps to maintain a humid environment in the incubator. If the water you use to fill water baths and trays is contaminated then this could lead to the dispersal of spore-generating fungi via incubator fans and laminar flow hoods.

Troubleshooting

Biological contaminants can persist for extended periods. Therefore, it is best practice to monitor your water and cells regularly to prevent these contaminants from compromising your experiments. You can detect biological contaminants using methods such as karyotyping, electrophoresis, turbidity testing, immunological tests or DNA fingerprinting.

It is also a good idea to keep good records of equipment, solutions, media and supplies, as this can help you identify the source of the issue should things go awry. Furthermore, it is important you test all new reagents, media, sera and water in addition to carrying out routine maintenance checks on incubators, hoods, water baths and water purification systems.

Adhering to good aseptic practice and a regular cleaning schedule can greatly reduce the chances of contamination in your cell cultures. You should make sure only sterile water is used when refilling the incubator reservoir and if possible, try to avoid using water baths altogether. Autoclaving and antibiotics can also aid in curing contamination, although they can have other unwanted effects on your experimental set-up.

Water purity is key to ensuring success in the cell culture laboratory, so we recommend that you use ultrapure Type I+ water. It is also important that water purification systems are well-maintained and consumables are changed regularly to ensure continued water quality. This is particularly important for IX resins, as these can harbor endotoxin-producing bacteria.

Cell culture checklist

- ✔ Use ultrapure Type I+ water
- ✔ Monitor water quality
- ✔ Keep good records
- ✔ Test new reagents
- ✔ Clean incubator & use sterile water in reservoir
- ✔ Clean water bath & avoid use if possible
- ✔ Use point-of-use filter water rather than bottled/stored
- ✔ Change consumables

Molecular biology (Problems, causes & troubleshooting)

Molecular biology typically includes the synthesis, modulation and study of molecules such as RNA, DNA and protein. Accordingly, you'll need to extract molecules before subsequently analyzing them using techniques such as quantitative PCR (qPCR), end-point PCR, *in vitro* transcription, ligation, chromatin precipitation, electrophoresis, western blotting etc. Factors such as poor primer design, sub-optimal thermocycling conditions and buffer misuse can influence the outcome of many of these procedures. In addition, poor quality water can introduce a number of potentially harmful impurities including degrading enzymes, ions, $MgCl_2$ and foreign DNA. This can result in unsuccessful extractions, non-specific or failed amplification and damage to equipment.

While a huge number of techniques are used in molecular biology, many rely on detecting a product of interest on an agarose or polyacrylamide gel. As such, we have focused our discussion on the extraction of products or template molecules, the amplification of RNA/DNA products of interest and the analysis of products by gel electrophoresis or qPCR.

Problems and causes

No template extracted

Most molecular biology experiments focus on RNA, DNA or protein molecules. Water is used throughout the process when extracting these factors from tissues, cells and *in vitro* systems. Therefore, it is important your water is free from contaminants in order to ensure that your experimental procedures can continue unhindered.

Degrading enzymes

Degrading enzymes include nucleases (RNAses and DNAses) and proteases, which target and destroy RNA, DNA and proteins respectively. If your water contains these enzymes, it can impede the extraction process and destroy the template, especially if you are using water as an eluent or as part of a resuspension buffer.

Gel electrophoresis problems

It is common practice to run PCR products on a gel prior to conducting downstream experiments such as sequencing or cloning. Similarly, proteins are often run on a gel as part of a western blot, before being transferred to a membrane for antibody staining.

Gel electrophoresis works by applying an electric current across a buffer-filled tank to encourage the negatively-charged sample to move towards the positive electrode and separate based on molecular size. Running and transfer buffers are prepared with water, so it's important you make sure it's free from impurities, such as ions, that might otherwise disrupt the electrophoretic process in your gel tank.

Ions

Ions are often found in low purity water and can disrupt the flow of electric current. If these are present at high concentrations in a buffer, your gel won't run properly and this in turn could lead to gel tank burnouts and poor results.

No amplification when performing PCR

It is often necessary to amplify DNA and RNA by means of PCR and reverse transcription for analysis. These processes rely on an intact template and the use of a polymerase enzyme such as *Taq* for successful amplification. Hence, it is important that the water you use when preparing the reaction buffer is free from contaminants.

Degrading enzymes

If the water you are using in the reaction mix contains enzymes such as nucleases, these will degrade the template. In addition, proteases could destroy the polymerase, impairing its ability to amplify the template (Figure 12).

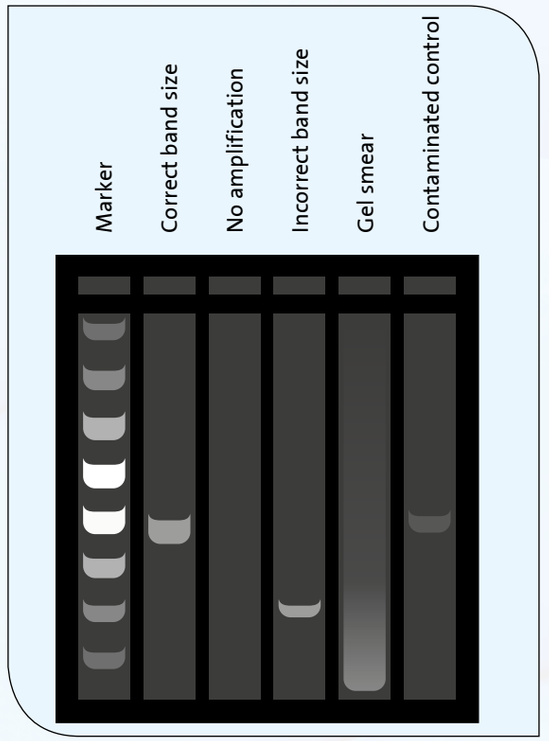


Figure 12: Illustration of an agarose gel showing various types of error that can occur when using poor quality water for PCR.

Incorrect product sizes and gel smears when performing PCR

Amplification errors can be a nuisance and compromise your downstream research. They often present in the form of primer dimers and result from poor experimental design. Here, we discuss how water impurities such as $MgCl_2$ and nucleases can generate incorrect band sizes and gel smears (e.g. see Figure 12).

$MgCl_2$

$MgCl_2$ is an essential cofactor for polymerase function. However, while it can help you boost polymerase activity in your PCR, this is often at the expense of specificity. Therefore, if you inadvertently add an excess of $MgCl_2$ to the reaction mix via an impure water supply, this could result in non-specific amplification, which will appear as smears or unexpected products on your gel.

Nucleases

Degradation of the template can result in the amplification of fragmented DNA in some cases. In others, the product is generated but then starts to degrade. In both cases, this will appear as a smear when you carry out gel electrophoresis.

No template control contamination when carrying out PCR

Well-planned experiments will include a negative control or 'blank'. This will ensure that your results are valid and not an unforeseen amplification event triggered by unexpected factors such as contaminating DNA. A common control contains no template and often involves replacing the sample (or template) with water in the reaction mix. Problems, can arise if the water you are using is contaminated with foreign DNA, such as that of bacteria. After enough cycles, this will amplify and show up in both your samples and controls (see Figure 12 and Figure 13). It can also compete with your template of choice, reduce the accuracy of your data and hinder the overall efficiency of your experiment.

Troubleshooting

Molecular biology applications are sensitive to a number of water impurities. Therefore, it is best to use sterile, nuclease-free, DEPC-treated, ultrapure Type I+ water for all your applications involving RNA, DNA and proteins. This should include the preparation of reaction buffers, blanks and template elution.

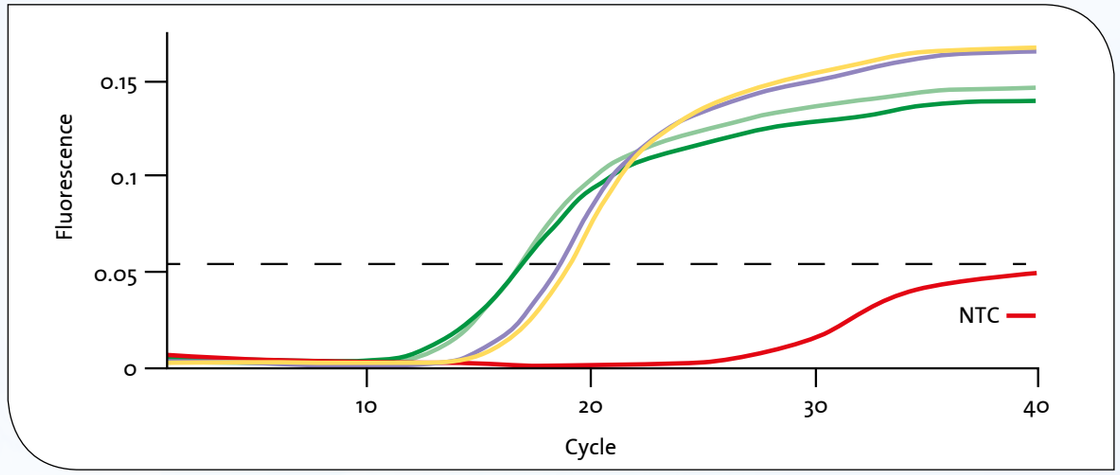


Figure 13: Illustration of a typical qPCR graph showing amplification of the contaminated no template control (NTC, red).

It is also vital that you maintain all your solutions within the appropriate pH range to preserve the sample.

Having taken measures to ensure you are using the highest quality water, you should aliquot your water to safeguard against repeatedly using a contaminated water source. You can also greatly reduce the chance of contamination if you use filter tips, as these act as a physical barrier to aerosol contaminants. In addition, working in a designated hood or area can further aid in preventing cross-contamination.

Lastly, you should use Type I purified water for the preparation of electrophoresis buffers, as this is of sufficient quality to ensure the uninterrupted flow of the electric current across the tank and the smooth running of your gel.

Molecular biology checklist

- ✔ Use DEPC-treated ultrapure Type I+ water for PCR & templates
- ✔ Use Type I pure water for electrophoresis
- ✔ Use filter tips
- ✔ Work in a designated area or hood
- ✔ Use point-of-use filter water rather than bottled/stored
- ✔ Change consumables

Conclusion

As we have discussed, water impurities can compromise your research, particularly for sensitive applications. Therefore, a better understanding of the potential problems will not only help in solving any issues that arise but will also prevent them occurring in the first place. Taking the quality of your water into careful consideration when designing and conducting experiments, as well as upholding GLP, will aid you in achieving experimental success.

In addition to ensuring you select the correct water purity for your application and maintaining your water purification system, you should keep an up-to-date record of laboratory reagent batches and usage, and monitor water purity levels and filter changes. This will mean you can rest assured that the data you are generating is accurate and will prevent a multitude of problems further down the line.

Pure water in tune with all your needs

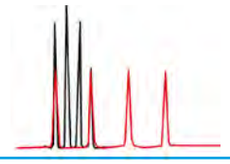
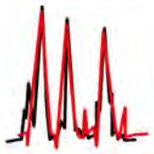
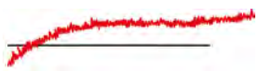
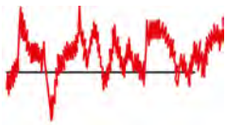
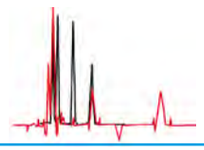
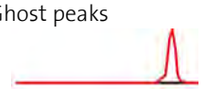
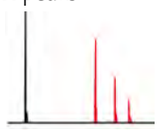
To help make sure you achieve the correct level of water purity for your application, we have developed a configurable system, the PURELAB Chorus. This not only allows you to design a system that best fits your current needs, but offers the added benefit of flexibility should your needs change in the future. No matter whether you need water for a sensitive HPLC experiment or washing glassware, there is a solution available.

The PURELAB Chorus 1 delivers the ultimate water purity for critical applications requiring ultrapure Type I and Type I+. PURELAB Chorus 2 provides basic RO/deionized Type II and Type II+ pure water direct from a potable tap water supply. For general use, PURELAB Chorus 3 offers primary RO grade water on demand. These systems can dispense a range of water qualities from different dispense points around the lab. A configurable system will not only ensure your water is right for your application, but it could save you money by ensuring you're not using expensive ultrapure water when you don't need to.

The Chorus systems are also futureproof with scalable storage solutions available should your future water reservoir requirements exceed your current needs. In addition to saving money, these systems won't compromise your bench space. This is because the reservoirs can be stored in a cupboard or wall mounted, and the Halo dispenser offers three remote dispensing and monitoring solutions.

Make sure your laboratory water purification solutions are in tune with your needs. Configure your system now.

Quick guide

Problem (Black=correct Red=problem)	Possible causes found in water	Solution
Liquid chromatography		
Variable retention time 	• Organics • Particulates • Bacteria	• Use ultrapure Type I+ water – Use point-of-use water purifier rather than bottled • Use HPLC-grade reagents (water/methanol/acetonitrile) – Don't exceed expiration date • Use glass storage containers • Avoid using plastic where possible • Only use dedicated glassware, which has been cleaned properly • Don't use detergents • Prevent atmospheric contaminants from entering – Prepare, filter & degas mobile phase daily – Flush mobile phase through system before starting – Don't store system in water • Ensure homogenous mobile phase • Change water and chromatography system filters regularly
Loss of resolution 		
Tailing peaks 		
Baseline drift 		
Noisy baseline 		
Negative peaks 		
Ghost peaks 		
Back pressure		
Adduct peaks 	• Metal ions	

Problem	Possible causes found in water	Solution
Cell culture		
Poor cell growth and cell death	• Metal ions & impurities • Endotoxins	• Use ultrapure Type I+ water • Monitor water and cells for biological contaminants • Keep good records of reagents, equipment, cleaning etc. • Test all new reagents before use • Maintain good aseptic technique • Ensure water purity for media and solutions but also water baths, incubators and autoclaves • Clean incubator and water baths regularly • Use point-of-use water rather than bottled/stored • Change consumables • Autoclaving & antibiotics can be used to remove contamination
Contaminated cultures (e.g. changes in turbidity, color etc.)	• Bacteria • Molds • Yeasts • Fungi	
DNA/RNA/Protein extraction and manipulation		
Electrophoresis problems (eg. tank burnouts, gel doesn't run properly)	• Ions	• Use Type I water for gel tank buffers
No template extracted	• Nucleases & proteases degrade template	• Use sterile, DEPC-treated, ultrapure, Type I+ water • Check resuspension buffer is appropriate pH • Use water aliquots • Use filter tips • Work in designated area/hood
No amplification Gel smears Incorrect product size	• Proteases degrade polymerase or target proteins • Nucleases degrade DNA/RNA • $MgCl_2$ affects specificity	
Contamination in the "no template control" for PCR reactions	• Foreign DNA present	

* Please note: This table serves to highlight where water impurities can lead to experimental error. However, these problems aren't limited to water and could potentially arise from alternate sources.

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The LabWater Specialists

ELGA is an integral part of Veolia, the global leader in optimized resource management. Veolia has a worldwide team of over 200,000 people and is renowned for its capabilities in providing water, waste and energy management solutions that contribute to the sustainable development of communities and industries.

The ELGA team focuses exclusively on water and its purification. It continually contributes to the unique technical and scientific applications and expertise developed for nearly 80 years. We are experienced in meeting the challenges that arise during the development, installation and servicing of single point-of-use water purification systems as well as large projects involving consultation with architects, consultants and clients.

Get in touch

If you would like to learn more about using pure water for highly sensitive analysis, please contact our team of experts. ELGA LabWater has been working in laboratory water purification exclusively for almost 80 years, making us the world leaders in this area.

As an organization, we’re committed to ensuring that those working at the bench receive the highest quality professionalism, and water, possible. If you’d like to start a research program operating at the limits of analytical detection, maybe we can help – get in touch now.

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