Lab disinfectants

Can the use of bleach in human identification DNA laboratories be problematic, and should it be replaced with DNA *AWAY* and RNase *AWAY* Surface Decontaminants?

Yes, bleach can be problematic and should be replaced with **Thermo Scientific™ DNA AWAY™ Surface Decontaminant** and **Thermo Scientific™ RNase AWAY™ Surface Decontaminant** for daily use throughout laboratory workflows. Inappropriate use of bleach in human identification (HID) DNA laboratories can contribute to the degradation of DNA samples and fluorescent dyes.

Laboratory contamination

Contamination can potentially disrupt the operations of an HID DNA laboratory. Consequences include loss of valuable samples, cross-contamination, and erroneous genotyping and misidentification of an individual. HID DNA laboratories can easily be contaminated with genetic material from polymerase chain reaction (PCR) amplification, a method that is a cornerstone of any DNA-based identification workflow. The PCR method is used to make many copies of (i.e., amplify) targeted portions of template DNA that comes from a sample of interest. Very low quantities or copies of target DNA can be amplified, resulting in production of many millions of identical copies at the end of the PCR process. Therefore, even a small quantity of unwanted (contaminant) DNA can also be amplified into many millions of copies. The amplified contaminant DNA can interfere with the laboratory's basic function, which is to produce DNA-based genotypes. This in turn can lead to significant material loss, societal impact, and delays in operation. HID DNA laboratories therefore implement, as part of their standard operating procedure (SOP), decontamination strategies that recommend the use of various decontaminants.

Bleach as a decontaminant

Bleach, diluted 3–6% sodium hypochlorite (NaClO), has been used as a common decontaminant in many HID DNA laboratories due to its characteristics as a disinfectant. However, problematic events can occur when using bleach, especially when personnel are working under conditions where a high volume of samples must be processed in a short amount of time. Possible errors can lead to unwanted consequences of slowing and even shutting down laboratory operations. Bleach has at least four undesirable properties that can interfere with HID DNA laboratory operations:

- Potential contributor to DNA sample degradation
- Possible cause of DNA sequence alterations
- Degradation of fluorescent dyes from bleach fumes
- Metal corrosion of laboratory equipment

First, it has been shown that bleach-contaminated samples show a partial DNA profile. Large loci (>200 bp) are dropped out of PCR amplification and genotyping due to DNA degradation, resulting in a partial profile that might not be sufficient for positive identification of an individual [1]. Second, bleach can be a cause of DNA sequence alterations, which too can affect genotyping if the alterations are in the primer-binding region of the DNA, potentially resulting in a partial or no profile at all [2]. Third, bleach fumes can degrade fluorescent dyes used in HID multiplex PCR kits, which also can lead to a partial or no profile [3]. Fourth, bleach can cause metal corrosion, damaging valuable equipment such as biosafety cabinets (BSCs) and instruments [4,5]. Some BSC manufacturers, including Thermo Fisher Scientific, explicitly state that the use of bleach in cleaning the BSC will result in voiding the warranty.

DNA *AWAY* and RNase *AWAY* Surface Decontaminants

DNA *AWAY* and RNase *AWAY* products have been tested by various groups and used as laboratory decontaminants for several years. They are recommended as the decontaminants of choice because of the following desirable properties:

- Demonstrated effectiveness in degrading contaminant DNA
- Efficient removal of DNA and RNase from laboratory surfaces
- No effect on fluorescent dyes
- Do not cause metal corrosion

It has been shown experimentally that RNase *AWAY* Surface Decontaminant is effective at degrading contaminant PCR products and genomic DNA. Contaminant DNA samples were prepared by adding aliquots of *Mycoplasma* PCR product or human genomic DNA (gDNA) to microcentrifuge tubes with or without RNase *AWAY* Surface Decontaminant. Samples analyzed by gel electrophoresis on the Invitrogen™ E-Gel™ Power Snap Electrophoresis Device (Cat. No. G8100) demonstrated no residual PCR products and human gDNA present for those tubes treated with RNase *AWAY* Surface Decontaminant, while the bands of samples in untreated tubes were visible for both the PCR product and human gDNA (Figure 1).

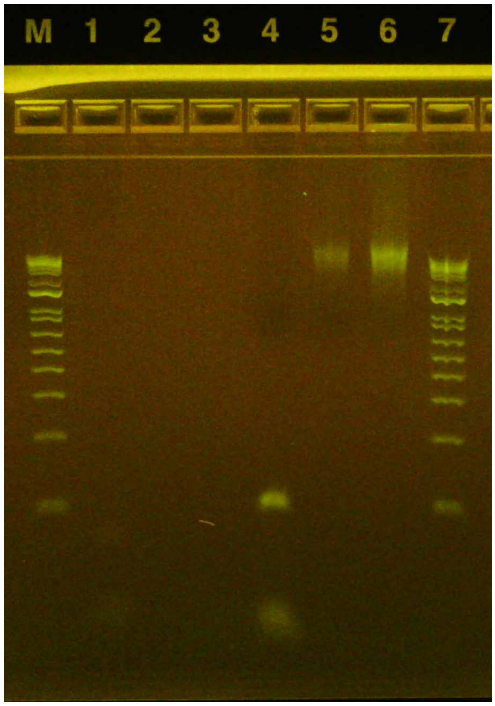

Figure 1. Degradation of contaminant PCR products and gDNA. Samples were run on an Invitogen™ E-Gel™ EX Agarose Gel, 2% (Cat. No. G402022). Lane M: Invitrogen™ E-Gel™ 1 Kb Plus DNA Ladder (Cat. No. 10488090). Lane 1: *Mycoplasma* PCR product treated with RNase *AWAY* Surface Decontaminant. Lanes 2 and 3: female and male human gDNA (Coriell Institute), respectively, treated with RNase *AWAY* Surface Decontaminant. Lane 4: *Mycoplasma* PCR product that was not treated. Lanes 5 and 6: female and male human gDNA, respectively, that were not treated. Lane 7: DNA ladder.

DNA *AWAY* Surface Decontaminant is designed to eliminate unwanted DNA on laboratory surfaces without affecting downstream PCR amplification. In one demonstration of its effectiveness, fish eggs were treated with full-strength DNA *AWAY* Surface Decontaminant to destroy exogenous DNA present on the exterior of the eggs [6,7]. After rinsing the eggs with DNA-free water, DNA was extracted from the eggs for successful PCR amplification. Thus, DNA *AWAY* and RNase *AWAY* products are recommended for decontaminating working surfaces, pipettes, and instruments throughout the PCR protocol, including before and after sample collection, sample DNA extraction, and PCR master mix preparation. Further, DNA *AWAY* Surface Decontaminant is recommended for all metal surfaces where, in addition to effective decontamination, a priority is to avoid corrosion.

Conclusion

Bleach decontaminants are often used in HID DNA laboratories to help prevent contamination in PCR-based workflows. However, use of bleach should be minimized because of its undesirable characteristics. Better choices for decontamination are DNA *AWAY* and RNase *AWAY* products, which are used in protocols and SOPs of many laboratories and institutions such as the US Centers for Disease Control and Prevention [8], the Houston Forensic Science Center [9], and the Environmental Toxicology Laboratory at the University of Saskatchewan [10]. DNA *AWAY* and RNase *AWAY* products are widely trusted for their desirable properties as effective surface decontaminants.

References

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