PAGE GelRed™ & PAGE GelGreen™

Designed specifically for polyacrylamide gel staining

Biotium scientists recognize that a fundamental approach for making a gel stain safe is to eliminate or minimize the chance for the dye to interact with genomic DNA in living cells. Based on this design principle, chemists at Biotium incorporated structural features to make the dyes impermeable to latex gloves, nitrile gloves, and cell membranes.

In the design of the original GelRed™ and GelGreen™ dyes, we achieved the dyes' membrane impermeability mainly by making the dyes physically large. While this strategy works extremely well to improve the dyes' safety and at the same time produces exceptional gel staining sensitivity for agarose gels, the relatively large size of GelRed™ and GelGreen™ make the dyes difficult to penetrate into the more densely packed polyacrylamide gels, rendering the dyes less optimal for PAGE gel staining. In designing PAGE GelRed™ and PAGE GelGreen™ dyes, we used a novel approach to make the dyes membrane impermeable without making the dyes large. Importantly, the new design strategy still ensures that the PAGE dyes possess essential properties for gel staining, including good sensitivity, stability and compatibility with existing instruments and downstream sample analysis.

The safety and sensitivity of GelRed™ and GelGreen™ now for PAGE gels

Figure 2. PAGE GelRed™ and PAGE GelGreen™ gel stains are safer because they cannot penetrate cell membranes to bind DNA in living cells. HeLa cells were incubated at 37°C with 1X SYBR Safe, 1X PAGE GelRed™, or 1X PAGE GelGreen™. Images were taken following incubation with dye for 30 min using FITC filter set for SYBR® Safe and PAGE GelGreen™, and Cy®3 filter set for PAGE GelRed™. SYBR® Safe rapidly penetrated cell membranes as evident from the bright green staining of nuclei and cytoplasm. However, PAGE GelRed™ and PAGE GelGreen™ were unable to cross cell membranes, as shown by the absence of fluorescence staining in healthy cells. Staining was observed in dead cells present sporadically in the cultures, as is observed with other non-membrane permeable nucleic acid dyes. The presence of cells in the field of view was confirmed by phase contrast microscopy (not shown).

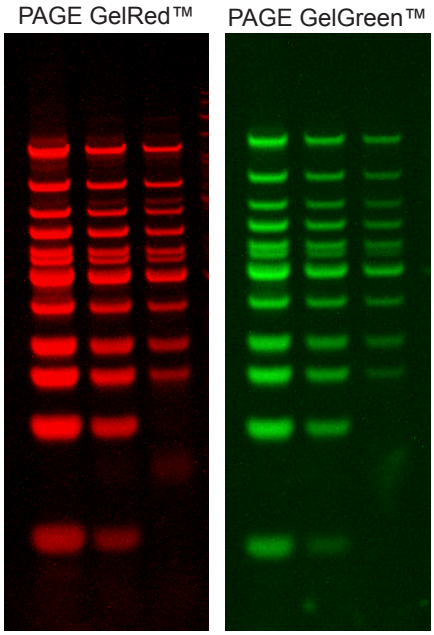

Figure 1. NEB low molecular weight ladder was separated on a 10% acylamide TBE gel (left to right, 500, 200, 100 ng/lane) and stained with 1X PAGE GelRed™ (left) or 1X PAGE GelGreen™ (right) in water for 30 minutes. Gels were imaged on a UV transilluminator using a UVP GelDoc-It imaging system with ethidium bromide filter for PAGE GelRed™ or SYBR® filter for PAGE GelGreen™, with 2 second exposure time.

Safer gel stains designed specifically for use in polyacrylamide gels

☑ Formulated in water and impermeable to latex and nitrile gloves

☑ Non-toxic and non-mutagenic in AMES test

☑ Non-toxic to aquatic life, OK for drain disposal by EPA Title 22 hazardous waste test

Download the complete PAGE GelRed and PAGE GelGreen Safety Report at www.biotium.com

Biotium
Glowing Products for Science™
www.biotium.com

GelRed™ & GelGreen™

Safe and sensitive nucleic acid gel stains

GelRed™ and GelGreen™ are next-generation fluorescent nucleic acid gel stains designed to replace the highly toxic ethidium bromide (EtBr). Developed by scientists at Biotium, GelRed™ and GelGreen™ are superior to EtBr and other EtBr alternatives by having a combination of low toxicity, high sensitivity and exceptional stability.

EtBr has been the predominant dye used for nucleic acid gel staining for decades because of its low price and generally sufficient sensitivity. However, EtBr is a highly mutagenic chemical. The safety hazard and costs associated with decontamination and waste disposal can ultimately make the dye expensive and inconvenient to use. For this reason, alternative gel stains, such as SYBR® dyes, have become commercially available in recent years. While these alternative dyes have reduced mutagenicity, they sacrifice sensitivity and stability. For example, SYBR® Safe has very limited sensitivity while SYBR® Green and SYBR® Gold are much less stable than EtBr. SYBR® dyes also enter cells rapidly to stain mitochondria and nuclear DNA, making it more likely for the dyes to be harmful to cells. Indeed, SYBR® Green I has been shown to strongly potentiate DNA mutation caused by UV light and other mutagens (Ohta, et al. Mut. Res 492, 91 (2001)).

Safer options for gel staining

To make safer gel stains, scientists at Biotium used a novel yet very simple concept: reducing genotoxicity by preventing the dyes from entering living cells. We believe that the mutagenicity of a DNA-binding dye can greatly reduced by denying it access to genomic DNA in living cells. Thus, we engineered the chemical structures of GelRed™ and GelGreen™ such that the dyes are incapable of crossing cell membranes. Ames tests have confirmed that GelRed™ and GelGreen™ are nonmutagenic at concentrations well above the concentrations used for gel staining. This is in contrast to SYBR® Safe, which reportedly could not be tested for mutagenicity at its working concentration due to excessive toxicity (download the GelRed and GelGreen Safety Report at www.biotium.com for details). Furthermore, environmental safety tests showed that GelRed™ and GelGreen™ are non-toxic to aquatic life. Because of this, GelRed™ and GelGreen™ are classified as non-hazardous waste, and can be disposed as regular trash or down the drain. For more information, please download the GelRed™/ GelGreen™ Safety Report at www.biotium.com.

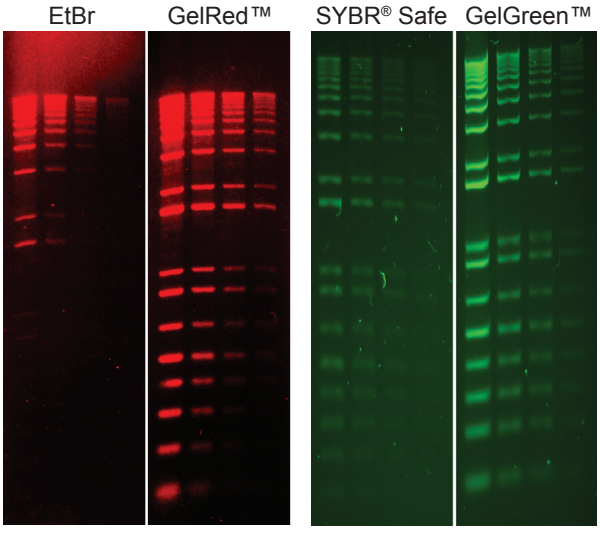

Figure 1. GelRed™ and GelGreen™ are more sensitive than EtBr and SYBR® Safe. Left: Comparison of GelRed™ and ethidium bromide (EtBr) in precast gel staining using 1% agarose gel in TBE buffer. Right: Comparison of GelGreen™ and SYBR® Safe in post gel staining using 1% agarose gel in TBE buffer. Two-fold serial dilutions of 1 kb Plus DNA Ladder from Invitrogen were loaded onto each gel in 4 lanes in the amounts of 200 ng, 100 ng, 50 ng and 25 ng, respectively, from left to right.

Figure 2. GelRed™ and GelGreen™ gel stains are safer because they cannot penetrate cell membranes to bind DNA in living cells. HeLa cells were incubated at 37°C with 1X SYBR® Safe, GelGreen™ or GelRed™, respectively. Images were taken following incubation with dye for 30 min using FITC filter set for SYBR® Safe and GelGreen™, and Cy®3 filter set for GelRed™. SYBR® Safe rapidly entered cells and stained nuclei. GelRed™ and GelGreen™ were unable to cross cell membranes, demonstrated by the absence of fluorescence staining. Staining was observed in dead cells present sporadically in the cultures, as is observed with other non-membrane permeable nucleic acid dyes (not shown). The presence of cell in the imaging field was confirmed by phase contrast microscopy (not shown).

FEATURES

Safer than EtBr
Shown by Ames test and other tests to be nonmutagenic and noncytotoxic.

Easy disposal
Passed environmental safety tests for direct disposal down the drain or in regular trash.

Ultra-sensitive
More sensitive than EtBr and SYBR® Safe.

Extremely stable
Stable in solution at room temperature.

Simple to use
For precast or post-electrophoresis gel staining.

Compatible with standard instruments
GelRed™ replaces EtBr; GelGreen™ replaces SYBR® dyes.

Compatible with downstream applications
Use your regular gel extraction kit to remove dyes from DNA for cloning or sequencing.

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