

## Propidium Iodide Nucleic Acid Stain

**P-1304** propidium iodide

**P-3566** propidium iodide, 1 mg/mL solution in water

**P-21493** propidium iodide, FluoroPure™ grade

### Quick Facts

#### Storage upon receipt:

- Solid PI (P-1304, P-21493), room temperature
- Solution of PI (P-3566), 2–6°C
- Protect from light

**Abs/Em:** 535/617 nm, bound to nucleic acids

### Introduction

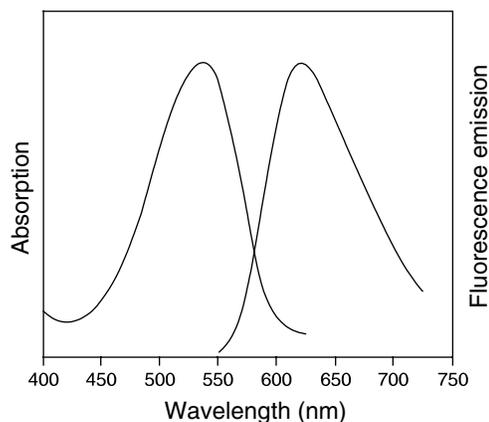
Propidium iodide (PI) binds to DNA by intercalating between the bases with little or no sequence preference and with a stoichiometry of one dye per 4–5 base pairs of DNA.<sup>1</sup> PI also binds to RNA, necessitating treatment with nucleases to distinguish between RNA and DNA staining. Once the dye is bound to nucleic acids, its fluorescence is enhanced 20- to 30-fold, the fluorescence excitation maximum is shifted ~30–40 nm to the red and the fluorescence emission maximum is shifted ~15 nm to the blue.<sup>2</sup> Although its molar absorptivity (extinction coefficient) is relatively low, PI exhibits a sufficiently large Stokes shift to allow simultaneous detection of nuclear DNA and fluorescein-labeled antibodies, provided the proper optical filters are used. PI is suitable for fluorescence microscopy, confocal laser scanning microscopy, flow cytometry and fluorometry.

PI is membrane impermeant and generally excluded from viable cells. PI is commonly used for identifying dead cells in a population and as a counterstain in multicolor fluorescent techniques. The counterstaining protocols below are compatible with a wide range of cytological labeling techniques — direct or indirect antibody-based detection methods, mRNA *in situ* hybridization or staining with fluorescent reagents specific for cellular structures. These protocols can be modified for tissue staining.

### Materials

#### Contents

Propidium iodide is supplied as 100 mg of a solid (P-1304), as 100 mg of a FluoroPure™ solid with purity ≥98% (P-21493) or as a 1 mg/mL solution in water (P-3566).



**Figure 1.** Absorption and fluorescence emission profiles of propidium iodide bound to dsDNA.

### Storage and Handling

Upon receipt, store the solid (P-1304, P-21493) at room temperature, protected from light. The solid should be stable for at least a year. Store the solution of PI (P-3566) at 2–6°C, protected from light. To make a stock solution from the solid form, dissolve PI (MW = 668.4) in deionized water (dH<sub>2</sub>O) at 1 mg/mL (1.5 mM) and store at 2–6°C, protected from light. When handled properly, solutions are stable for at least six months.

**Caution:** PI is a potential mutagen and should be handled with care. The dye must be disposed of safely and in accordance with applicable regulations. PI can be removed from aqueous solutions by filtration through activated charcoal. The charcoal and adsorbed dye must then be disposed of in a safe and appropriate manner.

### Fluorescence Spectral Characteristics

When bound to nucleic acids, the absorption maximum for PI is 535 nm and the fluorescence emission maximum is 617 nm (Figure 1). PI can be excited with a xenon or mercury-arc lamp or with the 488 line of an argon-ion laser. Generally, PI fluorescence is detected in the FL2 channel of flow cytometers.

### Protocol for Counterstaining Adherent Cells for Fluorescence Microscopy

#### Sample Preparation

Use the fixation protocol appropriate for your sample. PI staining is normally performed after all other staining. Note that permeabilization of the cells is required for counterstaining with PI.

### **RNase Treatment**

RNase treatment is required if the sample is fixed in paraformaldehyde, formaldehyde or glutaraldehyde. If the sample is fixed with methanol/acetic acid or acetone, RNase treatment is usually not required.

- 1.1** Equilibrate the sample briefly in 2X SSC (0.3 M NaCl, 0.03 M sodium citrate, pH 7.0).
- 1.2** Incubate the sample in 100 µg/mL DNase-free RNase in 2X SSC for 20 minutes at 37°C.
- 1.3** Rinse the sample three times, 1 minute each, in 2X SSC.

### **Counterstaining Protocol**

- 2.1** Equilibrate the sample in 2X SSC.
- 2.2** Make a 500 nM solution of PI by diluting the 1 mg/mL (1.5 mM) stock solution 1:3000 in 2X SSC. About 300 µL is usually enough stain for one coverslip preparation. Incubate the cells, covered with the dilute stain, for 1–5 minutes.
- 2.3** Rinse the sample several times in 2X SSC. Drain excess buffer from the coverslip and mount in a medium with an antifade reagent such as the one provided in Molecular Probes' *SlowFade*® Antifade Kit (S-2828), *SlowFade Light* Antifade Kit (S-7461) or ProLong® Antifade Kit (P-7481).
- 2.4** View sample using a fluorescence microscope with appropriate filters (see *Fluorescence Spectral Characteristics*).

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### **Protocol for Counterstaining Cells in Suspension for Flow Cytometry**

#### **Sample Preparation**

Use the fixation protocol appropriate for your sample, or use the following protocol.

- 3.1** Collect a volume of cell suspension corresponding to  $2 \times 10^5$  to  $1 \times 10^6$  cells. Pellet the cells by centrifugation. Discard the supernatant, tap the tube to resuspend the pellet in the residual liquid and add 1 mL of phosphate-buffered saline (PBS) at room temperature.
- 3.2** Transfer the full volume of resuspended cells to 4 mL of absolute ethanol at –20°C by pipetting the cell suspension slowly into the ethanol while vortexing at top speed. Leave the cells in ethanol at –20°C for 5–15 minutes.
- 3.3** Pellet the cells by centrifugation, discard the ethanol, tap the tube to loosen the pellet and add 5 mL of PBS at room temperature. Allow the cells to rehydrate for 15 minutes.

### **Counterstaining Protocol**

- 4.1** Make a 3 µM solution of PI by diluting the 1 mg/mL (1.5 mM) stock solution 1:500 in staining buffer (100 mM Tris, pH 7.4, 150 mM NaCl, 1 mM CaCl<sub>2</sub>, 0.5 mM MgCl<sub>2</sub>, 0.1% Nonidet® P-40). A 1 mL volume will be required for each cell sample.
- 4.2** Centrifuge the cell suspension from step 3.3, discard the supernatant, tap to loosen the pellet and add 1 mL of PI diluted in staining buffer. Incubate for 15 minutes at room temperature and analyze by flow cytometry in the presence of the dye. If the cells are to be viewed by fluorescence microscopy, centrifuge the sample, remove the supernatant and resuspend the cells in fresh buffer. Apply a drop of the suspension to a microscope slide, cover with a coverslip and view.

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### **Protocol for Chromosome FISH Counterstaining**

#### **Sample Preparation**

Prepare the specimen according to standard procedures.<sup>3,4</sup> Briefly rinse the final preparations in dH<sub>2</sub>O before counterstaining to remove residual buffer salts from the slide. Air dry. This final rinse will help reduce nonspecific background staining on the glass.

#### **Counterstaining Protocol**

- 5.1** Make a 1.5 µM PI staining solution by diluting the 1 mg/mL (1.5 mM) stock solution 1:1000 in PBS. Pipet 300 µL of this staining solution directly onto the specimen. If necessary, RNase A (freshly made) may be added to a final concentration of 10 µg/mL. A plastic coverslip can be used to distribute the dye evenly on the slide.
- 5.2** Incubate the specimen in the dark for 30 minutes at room temperature, or at 37°C if RNase is included.
- 5.3** Remove the coverslip and rinse briefly with PBS or dH<sub>2</sub>O to remove unbound dye.
- 5.4** Remove excess liquid from the slide by gently blotting around the sample with an absorbent tissue. Place a glass coverslip on the slide, and seal the edges with wax or nail polish. Alternatively, the preparation can be mounted in an antifade reagent according to the manufacturer's directions.
- 5.5** View sample using a fluorescence microscope with appropriate filters (see *Fluorescence Spectral Characteristics*).

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### **References**

- 1.** J Mol Biol 13, 269 (1965); **2.** Methods Cell Biol 30, 417 (1989); **3.** Methods Enzymol 168, 741 (1989); **4.** Pardue, M.L. in *Nucleic Acid Hybridization, A Practical Approach*, B.D. Hames and S.J. Higgins, Eds., IRL Press, Oxford, England (1985).

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**Product List** *Current prices may be obtained from our Web site or from our Customer Service Department.*

<b>Cat #</b>	<b>Product Name</b>	<b>Unit Size</b>
P-1304	propidium iodide.....	100 mg
P-21493	propidium iodide *FluoroPure™ grade*.....	100 mg
P-3566	propidium iodide *1.0 mg/mL solution in water* .....	10 mL

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