From crime scene to crime lab: potential interactions between blood detection methods

Crime scene investigators and forensic scientists at the crime laboratories both utilize rapid, presumptive tests to determine the likelihood of the presence of blood. At the crime scene, investigators commonly utilize Bluestar® or Luminol to produce a luminescence (emission of light or glow) within seconds of being sprayed on suspected blood (Fig. 1). The chemical reaction for this luminescence is mediated by the iron (Fe+2) in hemoglobin.

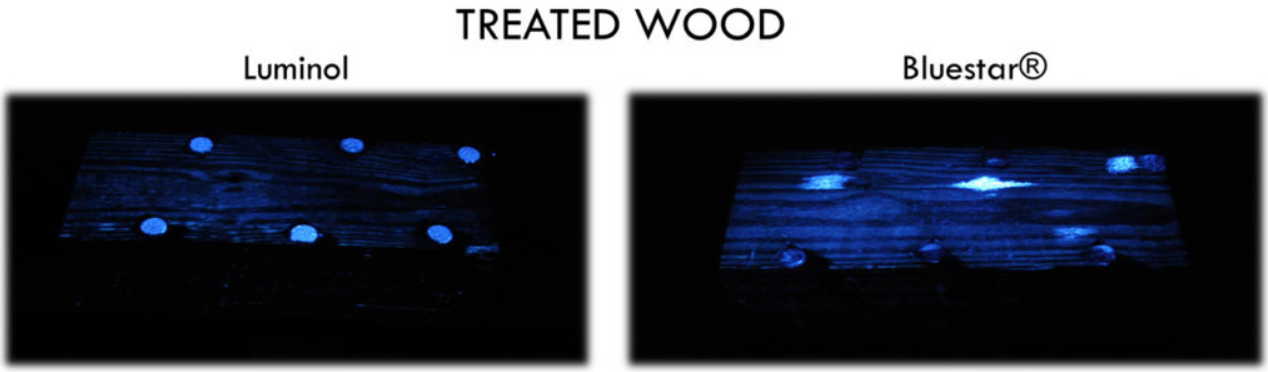

Fig. 1. Example of luminescence produced by luminol and Bluestar® on treated wood. Note the luminescence (glowing) on the wood itself. Treated wood can produce a false-positive as a result of the wood being treated with copper sulfate. The copper will catalyze the color change reaction in a fashion similar to iron in blood. A penny was placed next to the blood stain for ease of identification of the blood stained area on the treated wood.

This iron in hemoglobin is normally used to carry oxygen. Once the crime scene investigator determines that they may have blood, the evidence with the suspected blood is then collected and submitted to the forensic science laboratory (“crime lab”) for further analysis. At the crime lab, forensic biologists also run a rapid, presumptive test for the presence of blood. If this presumptive test is positive, the samples are then forwarded on for DNA analysis.

Two commonly utilized tests in the crime lab are tetramethylbenzidine (TMB) or phenolphthalein (PT). In the presence of Fe+2, TMB turns a blue-green color and PT turns pink within ten seconds (Fig. 2). Due to these presumptive blood tests have similar reactions recurring Fe+2, we investigated the effects of TMB and PT in the forensic laboratory analysis of blood when Bluestar® or luminol are utilized at a crime scene. Utilizing varying dilutions of blood from 1:1 to 1:100,000, six different substrates (untreated wood, pressure treated wood, ceramic tile, shag carpet, cement block, and cotton clothing) were stained and tested for positive reactivity to Bluestar® and Luminol, TMB and PT and combinations thereof. At concentrations of 1:100 or less, no interactions were

detected. However, interactions were seen at blood dilutions of 1:1,000 or greater. Bluestar® was the only presumptive test that can detect blood dilutions of 1:100,000 on some substrates and luminol was inclusive on pressure treated wood.

Fig. 2. Example of the color change induced by tetramethylbenzidine (TMB) or phenolphthalein (PT). In the presence of iron (Fe+2) in hemoglobin, TMB turns a blue-green color and PT turns pink within ten seconds.

These findings demonstrate the need for communication between the crime scene investigators and the bench scientists before presumptive blood tests are performed in the crime lab.

Jon E. Sprague
Ohio Attorney General's Center for the Future of Forensic Science
Bowling Green State University, Bowling Green, OH, USA

Publication

Technical note: The effects of Bluestar(®) and luminol when used in conjunction with tetramethylbenzidine or phenolphthalein.
Luedeke M, Miller E, Sprague JE.
Forensic Sci Int. 2016 May