A Comparison Between the Modified Griess Test and Use of Sodium Hypochlorite for Enhancement of Gun Shot Residue Patterns on Fabric[1]

James A. Bailey, PhD, Ruby S. Casanova, MS, and Kim Bufkin, Cape Fear Community College, 411 North Front Street, Wilmington, NC 28401

After attending this presentation, attendees will understand: (1) the comparison of the modified Griess test results compared to an application of a sodium hypochlorite solution as an agent for enhancing gun shot residue (GSR) powder patterns, (2) the results of the test on 12 samples of dark or multi-colored fabric, and (3) the advantages and disadvantages of using the modified Griess test and the sodium hypochlorite solution to enhance visualization of powder patterns. The purpose of this presentation is to present the results of an experiment that evaluated the modified Griess and a sodium hypochlorite solution used as a bleaching agent for the enhancement of GSR powder patterns at specific distances on dark or colored fabric targets.

Humanity demands that forensic scientists and jurists search for truth in the administration of justice. Without truth, the innocent may be punished and the guilty may be set free. This presentation will impact the forensic community and/or humanity by adding to the search for finding truth. The purpose of this research was to develop a more practical and economical method for enhancing gunshot residue patterns.

An essential element in reconstructing some crime scenes is to determine a weapon's muzzle to target distance. The determination of this distance can be estimated based on the size and intensity of the powder pattern if the type of ammunition and weapon are known. Dark or multi-colored fabrics interfere with the investigator's interpretation of powder pattern size and intensity. Tests were conducted to enhance visualization of powder patterns on dark or multi-colored fabrics.

GSR patterns have been classified as contact, near contact, intermediate-range, and long distance based on the size and intensity of the patterns. Even though the investigator may have a known type of
weapon and ammunition to test, the test firings cannot be used to establish a precise muzzle to target distance. However, in some cases the investigator may eliminate certain ranges of distances based on the GSR pattern characteristics. The GSR mainly consists of nitrates and nitrites from burned and partially burned propellant, carbon and metals such as barium, lead and antimony from chemicals used to manufacture primers. Also, there may be other trace element present in the residue depending on the type of ammunition. When a weapon is fired the propellant gases exit and materials contained in the gases are deposited on the target depending on the distance.

A model 686 .357 S&W revolver, with a 4-in barrel was used to produce GSR patterns by firing .38 caliber Winchester Western ammunition with lead round nose bullets into samples of dark or multi-colored fabric with a muzzle-to-target distance of 7.62 cm (3 in) for two groups of 12 samples. Group one of the samples was tested with the modified Griess test and group two was treated with sodium hypochlorite to compare the visualization enhancement of each method on the GSR pattern.

The materials prepared for the modified Griess test were 12 sheets of 203 x 254 mm (8 x 10 in) Kodak polycontrast RC (resin coated), type F photographic paper fixed

with Kodak fixer for 10 minutes at 20°C (68°F). After fixing, it was washed in 20°C (68°F) water for 10 minutes and dried in an RC dryer. The desensitized photographic paper was then immersed in a 5% solution of sulfanilic acid for 1 minute, dried at 20°C (68°F) then immersed in a 0.5% solution of Alpha-naphthol in methyl alcohol for 1 minute and dried at 20°C (68°F). Twelve pieces of 203 x 254 mm (8 x 10 in) cotton cheesecloth were soaked in 20% acetic acid for 1 minute. Each sample of fabric was then covered with a piece of treated photographic paper with the surface of the GSR pattern adjacent to the paper's emulsion. The piece of cheesecloth was placed on the back of the fabric sample and ironed on medium heat for 1 minute. And orange color developed on the photographic paper in the presence of nitrites. The photographic paper was then washed in 26°C (80°F) water for 1 minute and then washed with methyl alcohol.

A 5.25% solution of sodium hypochlorite was sprayed onto 12 samples of dark or multi-colored fabric to determine if bleaching the fabric would enhance visualization of GSR patterns. The solution was sprayed in a mist on each piece of fabric until saturated. In 2 to 3 minutes, the fabric colors began fading and losing color due to application of the sodium hypochlorite solution. A significant amount of the color was removed with the first application, and there was an observable difference in the visualization of the GSR patterns after sodium hypochlorite was applied. After 30 minutes, the fabric was sprayed with a second application. However, after the second application, there was minimal observable change in the visualization of the GSR pattern.

The 12 types and colors of fabric tested included: red, green, and beige plaid cloth with 100% cotton, striped navy and red with 100% cotton, striped navy, white, green and red with 100% cotton, burgundy with 100% cotton, black with red floral pattern with 100% rayon, beige, black, and purple floral design with 100% rayon, black with light colored floral design with 100% rayon, navy with 100% acetate, navy with 100% wool, black with 70% triacetate and 30% polyester, black and white with 50% polyester and 50% rayon, and black with 50% polyester and 50% rayon.

The GSR patterns on all samples were difficult to differentiate and measure on the untreated fabric. All 12 patterns developed with the modified Griess were orange in color and were measured and photographed for comparison to the patterns treated with sodium hypochlorite. Ten of the 12 samples treated by applying a 5.25% solution of sodium hypochlorite to bleach the dye from the fabric, produced enhanced GSR patterns. The 2 samples failing to yield improved visualization of the GSR patterns were the black 100% wool and the fabric containing 70% triacetate and 30% polyester. The bleach had no effect on the wool and the fabric with triacetate and polyester turned olive green but with no visual GSR pattern. The GSR patterns from the treatment of sodium hypochorlite were also measured and photographed.

The GSR maximum pattern diameters ranged from 5.5 cm (2.16 in) to 8 cm (3.14 in) for the twelve samples that were fired at a distance of 7.62 cm (3 in) with and average pattern diameter of 6.62 cm (2.60 in) for the modified Griess patterns. The GSR maximum pattern diameters for the twelve samples treated with sodium hypochlorite ranged from 1 cm (0.39 in) to 7 cm (2.75 in) fired at a distance of 7.62 cm (3 in) with and average diameter of 6.62 cm (2.60 in).

In conclusion, the use of sodium hypochlorite for enhancing GSR patterns is equivalent to the modified Griess test if the dark or multicolored fabric can be bleached. If the dye in the fabric cannot be bleached, the modified Griess test should be considered

for enhancement of the GSR pattern. One advantage of using sodium hypochlorite is that the fabric can be treated in a few minutes and the pattern is enhanced. Also, after treatment, there is an increased contrast in GSR patterns that allows routine photography of the fabric. The disadvantage of the modified Griess test is the time it takes to prepare the reagents for testing. Also noted were differences in color intensity for the Griess test possibly due to the composition of the fabrics used in the testing.

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