

Technical Procedure for the Examination of Pepper Spray

- 1.0 Purpose** – This technical procedure shall be followed for the examination of pepper spray.
- 2.0 Scope** – This procedure applies to the identification of oleoresin capsicum (OC) spray in which the active ingredients are capsaicinoids (e.g. capsaicin, dihydrocapsaicin, nordihydrocapsaicin), as found in pepper spray canisters. This procedure also applies to the identification of oleoresin capsicum spray on clothing and other objects.
- 3.0 Definitions** – N/A
- 4.0 Equipment, Materials, and Reagents**
- 4.1 Equipment**
- FT-IR
 - GC-MS
 - Vial crimper
 - UV Light / ALS
- 4.2 Materials**
- Forceps
 - Scissors/scalpel
 - Autosampler vials, 100 uL inserts, and crimp seals
- 4.3 Reagents**
- Chloroform
- 5.0 Procedure**
- 5.1 Analytical Approach**
- 5.1.1** Canisters and clothing are the two types of evidence typically encountered in pepper spray examinations.
- 5.1.2** The order of examination and selection of testing procedures shall be based on the quantity, quality, type of evidence, and the Forensic Scientist's training and experience.
- 5.1.3** Treat the questioned samples and any submitted standard samples in the same manner.
- 5.1.4 Canisters**
- 5.1.4.1** Weigh the canister to obtain the gross weight as received.
- 5.1.4.2** Spray the contents of the canister into a beaker. Note whether the actuator is working and if there was enough propellant to completely empty the canister.

5.1.4.3 Re-weigh the canister to get the empty weight.

5.1.4.4 Perform an Instrumental Analysis of the product. See 5.4.

5.1.5 Clothing or Other Objects

5.1.5.1 View the spray from the known canister submitted and determine if it fluoresces under ultraviolet light or with an alternate light source. If it fluoresces, or if no known canister was submitted, examine the evidence items under ultraviolet light or with an alternate light source.

5.1.5.2 Remove any suspected stains as described in 5.2. If no stains of interest are identified, proceed with the examination as described in 5.2.

5.1.5.3 Extract the sample. See 5.3.

5.1.5.4 Perform an instrumental analysis on the removed stains. See 5.4.

5.1.6 Perform any required comparisons, formulate a conclusion, and issue a report.

5.2 Removing the Stain from Clothing

5.2.1 If a stained area is visualized, remove a portion of the stain by cutting with scissors/new scalpel or scraping it off of the object. Remove an equivalent sized portion of an unstained area for use as a control, if possible.

5.2.2 If no stains are visible, remove portions of the garment from an area of the clothing where spray was reported to have been administered. Remove an equal sized portion of the clothing from an area of the garment farthest from the sampled area for use as a control, if possible.

5.3 Sample Extraction

5.3.1 For clothing and other items: extract the cuttings with chloroform, using the smallest volume to facilitate complete wetting of the cuttings and subsequent recovery of the solvent.

5.3.2 For Canisters: add a small amount of the spray to chloroform.

5.4 Instrumental Analysis

5.4.1 GC-MS Analysis

5.4.1.1 Analyze following the Trace Evidence Section [Technical Procedure for Gas Chromatography - Mass Spectrometry](#).

5.4.1.2 Concentrate or dilute sample as needed.

5.4.2 FT-IR Analysis

- 5.4.2.1 If there is a sufficient quantity of oil present, FT-IR analysis shall be performed.
- 5.4.2.2 Place a sample into a glass petri dish and place into a drying oven at a low temperature (50 °C - 100 °C) and evaporate until only the oil remains.
- 5.4.2.3 Analyze following the Trace Evidence Section [Technical Procedure for Infrared Spectroscopy](#).

5.5 Guidelines for Pepper Spray Analysis Result Statements

- 5.5.1 The reports shall read as listed below. The wording of the results shall accurately describe the evidence at hand.
- 5.5.2 **Functionality of the canister**
 - 5.5.2.1 The actuator is in working condition.
 - 5.5.2.2 The actuator is not in working condition; therefore, no analysis could be performed.
- 5.5.3 **Sufficiency of propellant to completely empty the canister**
 - 5.5.3.1 There was sufficient propellant to empty the canister completely.
 - 5.5.3.2 The canister did not have sufficient propellant to empty all the contents.
- 5.5.4 **Quantity of pepper spray remaining in the canister**
 - 5.5.4.1 The canister contained ____ grams/ounces of liquid.
 - 5.5.4.2 This amount was ____ % of the amount stated on the label for a full canister.
- 5.5.5 **Comparison of Oils (FT-IR analysis)**
 - 5.5.5.1 The pepper oil found in Item A was found to be consistent with the oil in Item B. Therefore, Item A could have originated from Item B.
- 5.5.6 **Identification of Capsaicinoids (GC-MS analysis)**
 - 5.5.6.1 The stain on Item A was found to contain capsaicin, the active ingredient in pepper spray.

5.6 Standards and Controls

- 5.6.1 When performing extractions, a blank of the extraction liquid and an unstained portion of the substrate shall be analyzed, if possible. If an unstained portion of the substrate is not possible, analyze the extraction solvent as the negative control.

5.6.2 The absence of any capsaicinoids is a valid negative control.

5.7 **Calibrations** – This procedure does not require any calibrations or performance checks. However, it does utilize instruments that require performance checks. See the individual technical procedures for the operations of those instruments.

5.8 **Maintenance** – No maintenance is required in this procedure. However, the procedure does utilize instruments that require maintenance. See the individual technical procedures for the operations of those instruments.

5.9 Sampling and Sample Selection

5.9.1 No sampling is performed. When sample selection occurs, it shall be based on the Forensic Scientist's training and experience.

5.9.2 Once capsaicin has been identified, or pepper oils consistent with a known standard are found on an object that was reported to have been worn by a particular individual, no further analysis shall be performed on any additional items from that same individual.

5.10 Calculations

5.10.1 Weight of spray left in the canister (that was able to be expelled from the canister)

5.10.1.1 $\text{Weight remaining} = \text{initial canister weight} - \text{empty canister weight}$

5.10.2 Percentage of spray left in the canister

5.10.2.1 Comparison to another identical canister of spray

5.10.2.1.1 Empty the full canister and calculate the weight remaining.

5.10.2.1.2 $\% \text{ of spray remaining in the canister} = \frac{\text{weight remaining in the questioned canister}}{\text{weight remaining in the full canister}} \times 100.$

5.10.2.1.3 In the results, it shall be noted that the percentage remaining in the questioned canister was calculated based on the volume of spray expelled from the unused canister. This takes into account the fact that there may not be enough propellant to expel all of the spray from the canister.

5.10.2.2 Comparison to the stated label volume

5.10.2.2.1 $\% \text{ of spray remaining in the canister} = \frac{\text{weight remaining in the questioned canister}}{\text{stated label weight}}$

5.10.2.2.2 In the results, it shall be noted that the percentage remaining in the questioned canister was calculated based on the weight stated on the canister. This does not take into account the fact

that there may not be enough propellant to expel all of the spray from the canister.

5.11 Uncertainty of Measurement – N/A

6.0 Limitations – N/A

7.0 Safety

7.1 Pepper sprays are strong lachrymators. Safety glasses and protective clothing shall be worn when working with this type of evidence.

7.2 All spraying shall be done in a fume hood.

7.3 Avoid contact with skin and eyes.

8.0 References

Iwai, K., et.al. “Simultaneous Microdetermination of Capsaicin and its Four Analogues by using High-Performance Liquid Chromatography and Gas Chromatography-Mass Spectrometry.” *Journal of Chromatography* 179 (1979): 303-311.

Kataoka, M., et al. “Stability and detectability of lachrymators and their degradation products in evidence samples.” *Journal of Forensic Sciences* 47.1 (2002): 44-51.

Lewis, K. and R.J. Lewis. “An assessment of four solvents for the recovery of 2-chlorobenzylidenemalononitrile and capsaicins from “CS” and “Pepper” type lachrymator sprays, and an examination of their persistence on cotton fabric.” *Journal of Forensic Sciences* 46.2 (2001):352-355.

Mongan, A. L. and E. Buel. “Identification of Dog Repellent in the Clothes of an Assault Suspect Using Gas Chromatography/Mass Spectrometry.” *Journal of Forensic Sciences* 40.3 (1995): 513-514.

North Carolina Justice Academy, Safe Use of Pepper Spray, 1993.

North Carolina State Bureau of Investigation, Oleoresin Capsicum Training, 1993.

Nowicki, J. “Analysis of Chemical Protection Sprays by Gas Chromatography/Mass Spectroscopy.” *Journal of Forensic Sciences* 27.3 (1982): 704-709.

Pennica, S.J. Considerations in Selecting Oleoresin Capsicum for Law Enforcement Agencies. NCSBI, 1993.

US Department of Justice. Oleoresin Capsicum: Pepper Spray as a Force Alternative. NIJ Technology Assessment Program, March 1994.

9.0 Records – N/A

10.0 Attachments – N/A

Revision History		
Effective Date	Version Number	Reason
09/17/2012	1	Original ISO Document