Forensic Technology Testing & Evaluation Report Form

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Project Information

Title: Quick Check™ Presumptive Drug Field Kits Evaluation
Evaluation Type: Reagent Kit
Stakeholder: Lynn Peavey Company, NFSTC FIDO Program
Start Date: 8/27/2007 End Date : 11/17/07

Manufacturer Information

Manufacturer: Lynn Peavey
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Evaluation Overview

A validation study was conducted on QuickCheck™ Drug Test Kits manufactured by the Lynn Peavey Company. Kit performance was assessed based on: sensitivity, specificity, reproducibility, and the impact of environmental stressors. The information gathered from the validation study will be made available to law enforcement agencies through the Field Investigation Drug Officer (FIDO) program developed by the National Forensic Science Technology Center (NFSTC). The program currently uses field based test kits for the presumptive identification of Cannabis, cocaine, methamphetamine, and heroin. These field test results are used to facilitate preliminary case adjudication and, if necessary, are confirmed by a complete laboratory analysis.

The National Forensic Laboratory Information System (NFLIS) lists Cannabis, cocaine, methamphetamine, and heroin as the controlled substances most frequently encountered by forensic laboratories. For this reason cocaine, methamphetamine, and heroin were chosen for this study. Cannabis was not addressed at this time.

Color test kits are an appropriate method for field application because of quickness, ease of use, and cost-effectiveness. A field test kit must meet the following criteria to be considered for inclusion in the FIDO program:

- Clear, unambiguous color to indicate a positive or a negative result
- Sufficient specificity to minimize false positive or false negative interpretation
- Adequate sensitivity to allow the detection of drugs at concentrations commonly encountered in street samples
- Reproducible results

Evaluation Team

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Product Specifications

Photos

Product Name & Number: QuickCheck™ Marquis (10123), Cocaine (10124), Heroin (10125), and Methamphetamine/Ecstasy (10122) Kits.

Serial/Lot Number: Not applicable

Brief Description

Color tests have been used in forensic analysis for decades to preliminarily screen samples for drugs of abuse. When combined with certain chemical reagents, many substances produce a clear, distinct, and predictable color. The color reactions are typically not specific to one compound, but are produced by many compounds within a drug class or by unrelated substances containing a common functional or structural group. It is important to note that aspects of color reactions have never been fully explained due to the frequent occurrence of anomalous responses. Unexpected color results and the inherent subjectivity of color interpretation emphasize the strictly presumptive nature of color tests. Their purpose is to indicate the possible presence or absence of certain substances in a sample. If unexpected or ambiguous results are observed from a color test, the sample should be subjected to confirmatory instrumental analysis for identification.

QuickCheck™ incorporates several new features in drug field test kits. The pouches are manufactured with a more translucent material and a white background for better visualization of test results. The pouches have a rounded bottom, eliminating the difficult task of removing drug sample from the pouch corners. Each pouch is equipped with a zip closing mechanism; it includes a collection device, written instructions, and a chemical resistant disposal bag.

Product Uses

Field test kits provide a quick, cost effective method for the presumptive screening of certain forensic samples for a range of controlled substances.

Storage Conditions: Room temperature
Operational Conditions: Not Applicable
Power Requirements: None
Cost: $19.95/box (ten kits)

Evaluation

Objective(s)
The objectives of the validation study were to assess the performance of the QuickCheck™ Field Test Kits with regard to: sensitivity, specificity, reproducibility, and the impact of environmental stressors.

Product Setup Performed by
☐ Manufacturer ☐ Manufacturer & NFSTC Lab Staff ☑ NFSTC Lab Staff Only

Product Setup Comment(s)
The QuickCheck™ kits are easily prepared for use. Each kit is fully equipped with written directions, a sample collection and loading device, and a chemical resistant disposal bag.

Minimum Skill Level of Operator as Set by Manufacturer
☑ Non-Scientist ☐ Technician ☐ Scientist

Standards, Controls and Samples Used In Evaluation

Drug Standards	
Cocaine HCl	Methamphetamine HCl
Cocaine Base (Secondary Standard)	Heroin (Secondary Standard)

Test Mixtures	
Drug Standard	**Cutting Agent**
Cocaine HCl	Boric acid, Caffeine, Mannitol, Procaine
Cocaine Base (Secondary Standard)	Benzocaine, Caffeine, Mannitol
Methamphetamine HCl	Caffeine, Dimethylsulfone (DMS), Niacinamide
Heroin (Secondary Standard)	Caffeine, Procaine, Quinine

Drug standards blended with cutting agents in the following w/w ratios: 80:20, 60:40, 50:50, 40:60, 30:70, 20:80, 10:90, and 5:95.

Substances Included in Specificity Study	
Acetaminophen	Inositol
Aspirin	Ketamine
Baking Soda	Lidocaine
Benzphetamine	Mannitol
Boric Acid	Mepivicane
Bupivicane	Niacinamide
Caffeine	Parmesan Cheese
Chlorpheniramine	Phencyclidine
Dextromethorphan	Powdered Milk
Dimethylsulfone (DMS)	Pseudoephedrine
Diphenhydramine	Quinine
Ephedrine	Tetracaine

Equipment and Consumables

- Mettler Toledo AB 104-S Analytical balance
- Metal spatulas
- Kim wipes
- Fisher Scientific Weigh Paper
- Munsell Book of Color
- Fisher Scientific Certified ACS Grade Methanol
- QuickCheck™ Test Kits
  - Cocaine QuickCheck™ Pouch
  - Marquis QuickCheck™ Pouch
  - Methamphetamine/Ecstasy QuickCheck™ Pouch
  - Heroin QuickCheck™ Pouch

Synopsis of Experiment(s)

The drugs included in this validation study with the corresponding kit(s) used for their analysis are:

- Cocaine HCl - QuickCheck™ Cocaine Kit
- Cocaine Base - QuickCheck™ Cocaine Kit
- Methamphetamine - Marquis QuickCheck™ Kit followed by the Methamphetamine/Ecstacy QuickCheck Kit™
- Heroin - Marquis QuickCheck™ followed by the Heroin QuickCheck Kit™.

The general procedure outlined below was followed in each section of the study. Details specific to each section of the validation study are listed under the appropriate heading.

General Procedure

- Each sample was weighed out in duplicate using an analytical balance.
- Each sample was placed into the appropriate QuickCheck™ kit.
- The ampoules within the pouch were broken according to the manufacturer's procedure.
- After 60 seconds, the color (if one developed) was matched to a chip in the Munsell Book of Color. The numerical values for hue, chroma, and value were recorded.
- Any kit anomalies or deficiencies were noted.

Sensitivity

- Three (3) milligram samples were tested.
- The pure drug standard and all the test mixtures listed under Standards, Controls, and Samples were evaluated in the appropriate kit(s).

Specificity

- Three (3) milligram and 10 milligram samples were tested.

Reproducibility

- Three (3) milligram samples were tested.
- The 80:20 and 40:60 ratios of Cocaine HCl, Cocaine Base, Methamphetamine, and Heroin with caffeine were the only Test Mixtures evaluated.
- Reproducibility trials were conducted over the course of ten consecutive work days.

Environmental Studies

- Three (3) milligram samples were tested.
- The 80:20 and 40:60 ratios of all four drugs with all of their associated cutting agents (in table above) were evaluated.
- The kits were subjected to one of four environmental conditions for 14 consecutive days:
    - Freezing Temperatures (-3 to -17 degrees C)
    - Refrigeration (2 to 5 degrees C)
    - Dry heat (40 degrees C)
    - Moist Heat (approximately 20 to 38 degrees C)

Interpretation Conditions

It is important to note the type of lighting used in the laboratory due to its effect on the perception of color in the test solutions and in comparison to the Munsell Book of Color. The laboratory used fluorescent bulbs: General Electric Watt-Miser II F40LW-RS-WMII Lite White 34 Watt. The test kits and color chips from the Munsell Book of Color were viewed at a 45 degree angle.

Kit Disposal

All used test kits were disposed of in an appropriate waste receptacle.

Findings

Strengths

- All four QuickCheck™ kits displayed sufficient sensitivity to detect the drugs of interest at concentrations commonly encountered in street samples.
    - Cocaine - The detection limit ranged from 10% to 20% drug content in the Cocaine Kit, with 20% being the most frequently observed detection limit.
    - Methamphetamine - The detection limit range was 5% to 30% in the Marquis kit and 5% to 10% in the Methamphetamine/Ecstacy kit. The higher detection limits in both cases were notated when niacinamide was the cutting agent.
    - Heroin - The Marquis kit exhibited a detection limit range of 5% to 30%. The higher detection limit was observed in mixtures containing quinine. A detection limit range of 10% to 40% was reported for the Heroin Kit. The 40% detection limit was observed in mixtures containing procaine.

- All four QuickCheck™ kits demonstrated reproducible results for all the drugs of interest over ten consecutive work days.

- Chemically, all of the environmentally stressed kits performed similarly to kits stored at room temperature with two exceptions:
    - After exposure to freezing temperatures, it took longer for the Methamphetamine/Ecstacy reagent to develop the final blue ink color. When mixed with methamphetamine, the solution started out purple and slowly turned the positive blue ink color. The color change was still within the 60 second timeframe.
    - After exposure to dry heat, two of the Marquis tests used to test methamphetamine mixtures produced a lighter orange color instead of the characteristic orange-brown color. This color was not considered in the positive range and was reported as inconclusive.

- Features of the QuickCheck ™, (i.e., clearer plastic, white background, rounded pouch bottom, zip closure, and instructions) enabled easier handling, test execution, and result interpretation.

Opportunities for Improvement

- False positives were observed throughout the specificity trials. For purposes of this study, a false positive was defined as a substance producing a comparable color as the drug of interest in the appropriate test. Substances producing false positives at the 3 milligram level are listed below.
    - Cocaine Kit - Benzphetamine, Bupivicaine, Ketamine, Lidocaine, Phencyclidine, and Tetracaine (Chlorpheniramine, Diphenhydramine, Quinine and Dextromethorphan produced a false positive at the 10 milligram level.)
    - Marquis Test - Benzphetamine, (Diphenhydramine and Quinine produced a false positive at the 10 milligram level.)
    - Methamphetamine/Ecstacy Test - None
    - Heroin Test- None

- Twelve kits (not subjected to environmental stressors) exhibited minor defects including broken or cracked ampoules, missing collection and loading devices, and several Mecke's kits contained small amounts of debris. On a few occasions the solution in the right ampoule of the Heroin kit had turned green before use. These kits were discarded without use.

- Some kits subjected to environmental stressors experienced physical changes.
    - The sealing mechanism of many kits exposed to dry and moist heat was damaged. This occurred most frequently and to the greatest degree in kits placed in the oven. The kits exposed to moist heat demonstrated this defect to a lesser degree.
    - The pouches of some kits exposed to dry heat were charred, impairing the analyst's ability to see through the plastic.
    - The ampoules in kits exposed to freezing temperatures were more brittle and prone to accidental breakage during incidental kit handling.

Limitations

- These kits are presumptive tests. They do not provide any structural information and are subject to false positives. For this reason, any samples producing ambiguous results should be sent to the laboratory for a complete analysis.
- Kits should not be used for the analysis of residues.
- Color interpretation is subjective, especially when analyte concentrations approach the detection limit of the assay or an interfering compound is present.
- Kits can be used only on powdered substances.
- Kits must be stored in environmental conditions that will not affect the integrity of the test kit or its components.
- Kits should not be utilized past the manufacturers recommended shelf life.
- Use of the Cocaine test kit to distinguish between cocaine salt and base is problematic. It is not recommended to employ field test kits for this purpose.

Training Requirements

- Users should complete a training program that includes:
    - Practical assessments
    - Competency demonstration
    - Written examination
    - Proficiency testing

Health and Safety Issues

- Wear personal protective equipment, including gloves and eye protection, when using presumptive kits.
- Keep pouch away from the face.
- Vent pouch if gas forms.
- Be aware of broken glass puncturing the pouch.
- Be aware of kit expiration or degradation of reagents.
- Dispose of kits appropriately.