Technical Note

A New, Highly Specific Color Test for Ketamine

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ABSTRACT: A new color test for the screening/presumptive identification of ketamine is reported. Treatment of ketamine with alkaline gold bromide produces a deep purple color within approximately one minute that changes to dark, blackish-purple within approximately two minutes. The color, color change, and time frames constitutes a highly specific screening test for ketamine. Of particular note, the test is negative for amphetamine, methamphetamine, MDA, MDMA, and phencyclidine (PCP), all of which are occasionally encountered in combination with ketamine.

KEYWORDS: Ketamine, Gold Bromide, Color Test, Screening Test, Forensic Chemistry

Introduction

Ketamine (Figure 1) is a medical and veterinary anesthetic and a controlled substance (Schedule III in the United States). Due to its anesthetic and hallucinogenic properties, ketamine is increasingly abused (1-3). Because its synthesis is challenging, its presence in illicit drug markets is almost universally due to diversion of pharmaceutical stocks. It is available in powder, liquid, and solid dosage forms, and for abuse purposes is smoked, snorted, injected, or taken orally. More recently, ketamine is being increasingly encountered as an added component in Ecstasy-type tablets. Other controlled substances that are occasionally encountered mixed with ketamine in Ecstasy-type tablets include (but are not limited to): Amphetamine, methamphetamine, methylenedioxyamphetamine (MDA), methylenedioxymethamphetamine (MDMA), and phencyclidine (PCP).

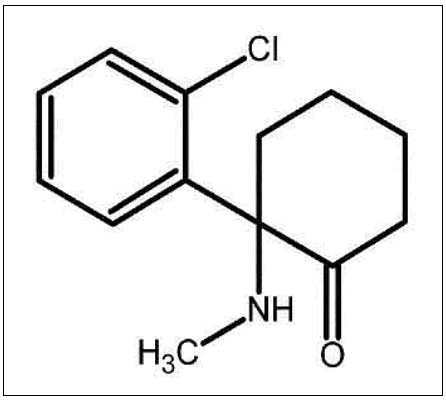

Figure 1. **Ketamine** ((+/-)-2-(2-Chlorophenyl)-2-(methylamino)cyclohexanone); $C_{13}H_{16}ClNO$; m.w. (Base) = 237.7, (HCl) = 274.2.

There are numerous analytical methods for the identification of ketamine in forensic and toxicological laboratories (4-13); however, until recently only one color test (the Janovsky reagent (11,14)) was available for screening purposes. Unfortunately, although moderately specific the Janovsky reagent (alkaline *meta*-dinitrobenzene) is rather insensitive (detection limit about 1.25 milligrams) and is therefore infrequently used for screening of mixed samples or solutions. In early 2007, Morris reported a modified cobalt thiocyanate color test for ketamine that is highly specific (15); however, it is also rather insensitive (detection limit also about 1.25 milligrams). Herein, a new presumptive color test for the preliminary screening of ketamine is reported. The test is simple, easy to perform, nearly twice as sensitive as the Janovsky and Morris tests, and highly specific.

Experimental

Materials: All standards used were from Sigma, Alltech, and Matheson. Gold bromide and sodium hydroxide were both analytical grade.

Reagents: A 0.5 % solution of gold bromide was prepared in deionized water, resulting in a brownish yellow colored solution. A 0.2 M solution of NaOH was also prepared in deionized water.

Method: One drop of 0.5 % gold bromide solution and one drop of the 0.2 M NaOH solution were combined in a spot plate well. A small amount of the substrate was added to the spot well and mixed, and the color monitored over approximately the next 2 minutes.

Results and Discussion

A literature search indicates that gold bromide has not been previously reported for color testing; however, acidified gold bromide has been used in a rather obscure microcrystal test for caffeine (16-18).

As noted in the Experimental section, the alkaline gold bromide test reagent is brownish-yellow in color. Upon treatment with the test reagent, ketamine gives a deep purple color within approximately one minute, that turns to a dark, blackish-purple color within approximately two minutes. A blank does not produce any color changes. Forty-seven other compounds (illicit drugs, adulterants, and diluents) which are frequently encountered in forensic laboratories were also tested (see Table 1, next page). A few of these compounds produced the same purple color as ketamine, but in all such cases there was a major time difference for the development of the color. A few compounds having hydroxyl or phenolic groups (acetaminophen, ascorbic acid, lactose, mannitol, morphine, and sucrose) gives the purple color almost instantaneously. Similarly, heroin (both standard and street-level) also gives the purple color almost instantaneously (the observation that heroin standard gives a positive test confirms that the positive test for street-level heroin was not just due to the presence of morphine or sugars). However, none of the tested compounds gave the color and color change like ketamine over the two minute time frame. In addition, none of the other amine drugs tested gave a positive test, including those most commonly encountered in combination with ketamine in illicit samples. Ketamine is not commonly encountered in combination with heroin, morphine, or the other tested diluents that do give an instantaneous color development - nonetheless, if a nearly instantaneous color change is observed, the test cannot be used for presumptive identification of ketamine.

As noted in the Introduction, the Janovsky and Morris tests have limits of detection of approximately 1.25 milligrams, in both cases requiring additional efforts to maximize sensitivity. The limit of detection for the presented test, with no special efforts to maximize sensitivity, was 0.8 milligrams - nearly twice as sensitive.

The initial purple color may be due to the formation of a complex between the gold and the ketamine. The cause for the change of color from purple to dark blackish-purple is unknown; however, it may be due to a redox reaction that produces a small amount of colloidal gold.

Table 1. Color Testing Results.

Compound	Observation of Color	Compound	Observation of Color
Ketamine	+	Acetaminophen	+
Methamphetamine	-	Alprazolam	-
Amphetamine	-	Ascorbic acid	(+)
Starch	-	Benzocaine	-
Diazepam	-	Bromazepam	-
Flunitrazepam	-	Butalbital	-
Phenobarbital	-	Caffeine	-
Heroin	+	Clonazepam	-
Diphenhydramine	-	α-Lactose	+
Sucrose	+	Lidocaine	-
Codeine Base	-	Lorazepam	-
MDMA	-	Manitol	+
Cocaine base	-	Sodium Chloride	-
Clonazepam	-	Nicotinamide	-
Morphine	+	Nitrazepam	-
MDA	-	Oxazepam	-
PCP	-	Pentazocine	-
Butalbital	-	Quinine	-
Cocaine HCl	-	Stearic acid	-
Fentanyl Citrate	-	Temazepam	-
Phentermine	-	Triazolam	-
Quinine HCl	-	Calcium Carbonate	-
Codeine HCl	-	Butalbarbital	-
Morphine Sulfate	+	Sodium Carbonate	-

Conclusions

The presented color test can be used either as a standalone screen or in combination with either or both the Janovsky reagent or the new, modified cobalt thiocyanate test by Morris. The three tests are highly complementary in that only a few (and different) compounds interfere with each test; therefore, use of any two and certainly all three would constitute a uniquely specific screen and presumptive identification of ketamine, either alone or in combination with other controlled substances and/or adulterants, so long as at least 1.25 milligrams of ketamine is present in each test sample.

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