Training Procedure for Origins, Extractions and Separations of Drugs

1.0 Purpose – This training will explore the origins and synthesis of commonly encountered controlled substances and the extraction methods used to isolate them from non-controlled cutting agents, diluents, and adulterants. Solubility differences, acid/base extractions and liquid extractions are useful techniques when it becomes necessary to isolate or separate components of a mixture in order to identify the controlled substance(s). A liquid extraction utilizes an organic solvent alone or in combination with an inorganic acid or base. Occasionally, it is possible to separate controlled substances based on their appearance.

2.0 Scope - This procedure applies to trainees in Drug Chemistry at the Raleigh, Triad and Western locations of the State Crime Laboratory.

3.0 Procedure

3.1 Objectives

3.1.1 Be familiar with the Drug Chemistry Technical Procedure for Extractions and Separations, and be able to explain expiration dates and quality control re-checks of prepared reagents used in extraction procedures.

3.1.2 Understand the concepts of acid and base.

3.1.3 Be able to identify whether a substance has acidic or basic properties based on structure.

3.1.4 Be able to identify the solubility of base and salt forms of drugs in various solvents.

3.1.5 Be able to extract an assortment of drugs mixed with a variety of non-controlled diluents and other controlled substances.

3.1.6 Be able to explain the origin and illicit syntheses of common controlled substances.

3.1.7 Review the Extraction section of the Drug Chemistry worksheet in FA with the Extraction block Training Assistants (or his/her designee).

3.1.8 Successfully complete a written exam.

3.2 Study Questions

3.2.1 What is an acid? What is a base? List some examples of each.

3.2.2 What are a conjugate acid and a conjugate base?

3.2.3 What are two structural considerations that effect the acidity and basicity of compounds? Explain.

3.2.4 Explain the difference between strong/weak acids and strong/weak bases. Give some examples of each. Include an explanation of pKa.

3.2.5 What is produced when equimolar amounts of a strong acid is combined with a strong base?

All copies of this document are uncontrolled when printed.

3.2.6 What types of compounds are best extracted with strong base?

3.2.7 What types of compounds are best extracted with weak base?

3.2.8 Review the structures of controlled substances listed in 4.2.4 of the Drug Chemistry Training Procedure for Drug Classification and Structure. Most controlled substances are considered basic. What functional group imparts this characteristic?

3.2.9 Some drugs are considered acids. Give some examples of acidic drugs and identify the functional group that imparts this characteristic.

3.2.10 What generally occurs when an inorganic acid is added to the base form of a drug?

3.2.11 Explain why a salt is soluble in water, but not in an organic solvent.

3.2.12 True or False – The extractions listed in the technical procedures will always work on both the salt and the base form. Explain your answer.

3.2.13 Explain why a sugar such as inositol is soluble in water, but not in an organic solvent.

3.2.14 Describe what happens during the liquid–liquid chemical extraction of a drug.

3.2.15 Where does cocaine originate and how is it manufactured?

3.2.16 What is the difference between cocaine base and cocaine hydrochloride?

3.2.17 Name some artifacts that might be present in illicit samples of cocaine.

3.2.18 Where does heroin originate and how is it made?

3.2.19 What artifacts can be present from heroin synthesis?

3.2.20 Where does LSD originate and how is it made?

3.2.21 What is GHB? Explain the relationship between GBL and GHB.

3.2.22 What happens when an acid or base is added to GHB?

3.2.23 What drug can be synthesized from Safrole/Isosafrole?

3.2.24 What does the term hygroscopic mean?

3.3 Practical/Laboratory Exercises

3.3.1 Determine by experimentation, or give an explanation as to which of the following organic solvents are miscible with water and which are not.

- Methanol
- Ethanol
- Hexane
- Chloroform
- Acetone

All copies of this document are uncontrolled when printed.

- Ethyl ether
- Petroleum ether
- Ethyl acetate

3.3.2 Observe the Training Coordinator (or designee) perform the most commonly used extraction/separation techniques listed in the Drug Chemistry Technical Procedure for Extractions and Separations.

- Propose extraction schemes to separate the controlled substances from a set of known drug combinations provided to you by the Training Coordinator. When options are available, propose more than one for commonly seen mixtures.
- Review your proposed extraction methods with the Training Coordinator, then isolate the controlled substance(s) and identify using IR Spectroscopy, if a sufficient amount of precipitate is recovered after extraction.
- If sufficient precipitate is not obtained for IR analysis, label the vial of precipitate and reserve for further analysis in the GC-MS Section of the Drug Chemistry Training Program.

3.3.3 Discuss with the Training Coordinator or his/her designee the types of drugs to extract and identify using verified extraction procedures.

3.3.4 Discuss types of paraphernalia with training staff and which type of extraction is performed on such submissions.

3.3.5 Discuss LSD/NBOMe blotter paper (or like submissions) and the most appropriate extraction methods to use on these materials.

4.0 Required Reading

Casale, J.F and R.F.X. Klein. "Illicit Production of Cocaine." *Forensic Science Review*. Vol 5, No. 2, (Dec. 1993).

5.0 References

Cantrell, T.S., John Boban, Leroy Johnson and A.C. Allen. "A Study of Impurities Found in Methamphetamine synthesized From Ephedrine." *Forensic Science International*, 39 (1988): 39-53.

Clandestine Laboratory Investigating Chemists. "A Review of the Birch Reduction Method." *8th Annual Technical Training Seminar Manual*. (1998).

Karch, Steven B. *The Pathology of Drug Abuse*. CRC Press: 1993.

Casale, John F. and Richard W. Waggoner. "A Chromatographic Impurity Signature Profile Analysis for Cocaine Using Capillary Gas Chromatography." *Journal of Forensic Sciences*. Vol. 36, No. 5, (Sept. 1991): 1312-1330.

Casale, J.F and R.F.X. Klein. "Illicit Production of Cocaine." *Forensic Science Review*. Vol 5, No. 2, (Dec. 1993).

Couper, Fiona J. and Barry K. Logan. "Determination of Gamma Hydroxybutyrate (GHB) in Biological Specimens by Gas Chromatograpy-Mass Spectrometry." *Journal of Analytical Toxicology*. Vol 24, (Jan-Feb 2000): 1-6.

Streitwieser, Andrew, Jr. and Clayton H. Heathcock. *Introduction to Organic Chemistry*. MacMillan Publishing Co.: 1976, 494.

6.0 Records

- Drug Chemistry - Training Checklist
- Section Completion Summary

7.0 Attachments - N/A

Revision History		
Effective Date	Version Number	Reason
09/17/2012	1	Original Document
12/06/2013	2	Added issuing authority to header
04/18/2014	3	**3.3.2** – Added instruction to observe Training Coordinator (or designee) perform the most commonly used extraction/separation techniques, and when options allow, propose more than one extraction scheme for training mixtures
10/19/2015	4	**Header –** Revised issuing authority **3.2** – Edited study questions to illicit more specific information on answers. **3.3.3** – Edited list of example drugs to extract. **3.3.4** – Added practical to discuss analysis of paraphernalia **3.3.5** – Added practical to discuss blotter paper submissions **4.0** – Added required reading
08/17/2018	5	**3.1.7 –** Added to objectives **3.2.3, 3.2.6, 3.2.7 –** added to study questions **3.3.3** – edited to remove actual substances since these will vary depending on the availability

All copies of this document are uncontrolled when printed.