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The use of methylamphetamine chemical profiling in an intelligence-led perspective and the observation of inhomogeneity within seizures

Marie Morelato [a], Alison Beavis [a], Mark Tahtouh [b], Olivier Ribaux [c], K. Paul Kirkbride [d], Claude Roux [a,*]

[a] Centre for Forensic Science, University of Technology, Sydney, Broadway, NSW, Australia
[b] Forensics, Australian Federal Police, Sydney, NSW, Australia
[c] Ecole des Sciences Criminelles, Université de Lausanne, Lausanne-Dorigny, Switzerland
[d] School of Chemical and Physical Sciences, Flinders University, Bedford Park, South Australia, Australia

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ABSTRACT

This study focuses on methylamphetamine (MA) seizures made by the Australian Federal Police (AFP) to investigate the use of chemical profiling in an intelligence perspective. Correlation coefficients were used to obtain a similarity degree between a population of linked samples and a population of unlinked samples. Although it was demonstrated that a general framework can be followed for the use of any forensic case data in an intelligence-led perspective, threshold values have to be re-evaluated for each type of illicit drug investigated. Unlike the results obtained in a previous study on 3,4-methylenedioxymethylamphetamine (MDMA) seizures, chemical profiles of MA samples coming from the same seizure showed relative inhomogeneity, limiting their ability to link seizures. Different hypotheses were investigated to obtain a better understanding of this inhomogeneity although no trend was observed. These findings raise an interesting discussion in regards to the homogeneity and representativeness of illicit drug seizures (for intelligence purposes). Further, it also provides some grounds to discuss the initial hypotheses and assumptions that most forensic science studies are based on.

1. Introduction

Amphetamine-type substances (ATS) are reported as the second most widely used illicit drugs after cannabis [1]. Furthermore, seizures of ATS have greatly increased in the past few years, attributed primarily to the increased number of methylamphetamine (MA) seizures. This trend was also noticed in Australia in 2011–2012 where both the number and in particular the weight of ATS detections at the Australian border increased [2].

MA and 3,4-methylenedioxymethylamphetamine (MDMA) are both representative of ATS. Although they share some chemical similarities, their syntheses are distinct, requiring different chemicals and precursors which produce different impurity profiles. A previously reported study assessed the use of MDMA chemical profiles in an intelligence perspective [3]. It was demonstrated that the application of one chemical profiling technique was sufficient to obtain timely links between samples to be used for intelligence purposes. Linkage between samples is a complicated notion as a link can be obtained at different levels and using different descriptors. The notion of link is large and complex. As a consequence, for the purpose of this article, the notion has been simplified as a relationship established between forensic entities (e.g. illicit drug samples) sharing similar features that stems from the hypothesis of a common cause (in this particular study, the same seizure). The comparison of physical or chemical profiles of different samples may lead to the establishment of a link and the interpretation of this link may indicate a common source [4].

In Australia, MA is usually synthesised from ephedrine or pseudoephedrine with a much smaller amount being prepared from 1-phenyl-2-propanone (P2P) [5]. Ephedrine/pseudoephedrine can be either derived from the *Ephedra bush* (natural), semi-synthetic (prepared by chemical synthesis from natural materials, in particular the fermentation of benzaldehyde) or manufactured synthetically (synthesised from propiophenone) [6,7]. Pseudoephedrine is mostly produced by the acid isomerisation of ephedrine. The restrictions on one precursor may lead to substitution of other chemicals in the

* Corresponding author. Tel.: +61 2 95141718; fax: +61 2 95141460.
E-mail address: Claude.Roux@uts.edu.au (C. Roux).

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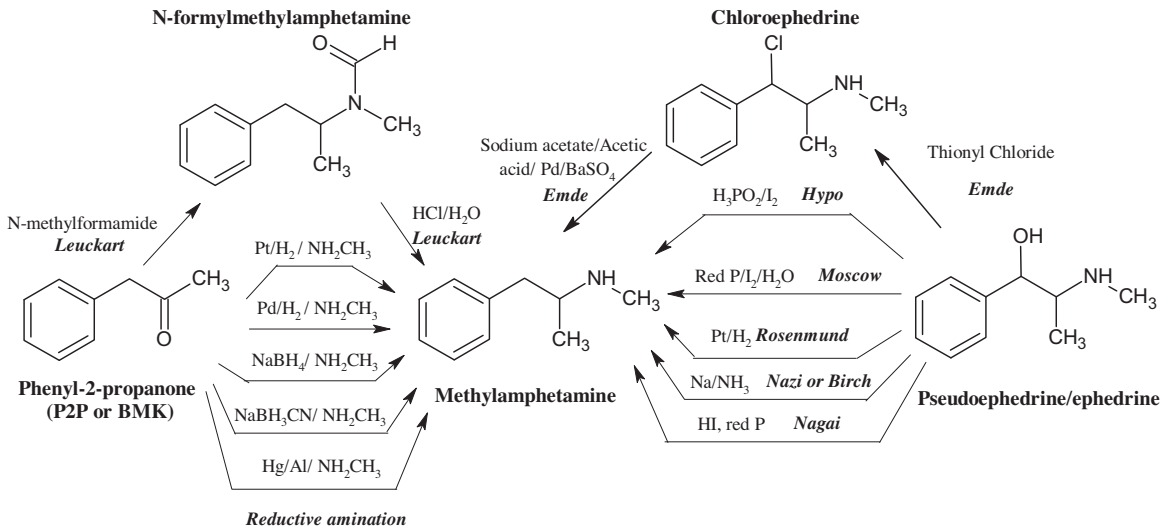

Fig. 1. Most common routes of MA synthesis.

production process. For instance, there are reports of laboratories replacing ephedrine/pseudoephedrine with alternate or modified precursors not under international control such as alpha-phenylacetoacetonitrile (APAAN), which can easily be converted into P2P [2,8].

The production processes are generally simple and the syntheses do not necessitate a chemistry background. Furthermore, chemicals used for its synthesis are available from commercial or industrial sources (e.g. pharmaceutical and agricultural industries). There are significant numbers of recipes for manufacturing MA [9–12], each one resulting in an impurity profile that is greatly influenced by the chemicals and precursors used as well as the equipment and different reaction stages [13,14]. The most common methods used by clandestine laboratories are:

(a) P2P-based methods, which yield racemic MA (D and L) or pure D-MA after isomeric separation.
(b) Ephedrine/pseudoephedrine-based methods, which yield the more potent D-MA if L-ephedrine or D-pseudoephedrine are used as precursors or a mixture of D and L-MA if a mixture of ephedrine/pseudoephedrine isomers are used.

These routes are summarised in Fig. 1.

In Australia, the most popular synthesis method is the Hypo route [2]. Illicit MA is generally available in two different chemical forms: base and hydrochloride salt (HCl). The HCl salt is the most common form seized in Australia. It can have different physical appearances and may, for instance, be sold as tablets, crystals or in powder form. A variant in the form of a red liquid (“oxblood”) is also produced but uncommon [2,15].

Since MA is a synthetic illicit drug, it can either be manufactured domestically or imported. It is suggested that the MA manufactured in Australia is produced in small, not always sophisticated laboratories (sometimes referred as “boxed labs” or “boot labs”) due to the simplicity and flexibility of the production processes [6]. This is supported by the detection of high quantities of precursors at the Australian border and the detection of 552 ATS (excluding MDMA) clandestine laboratories within Australia in 2011–2012 (out of a total number of 809 clandestine laboratories detected that year) [2]. Large amounts of MA are also imported into Australia, usually in a highly concentrated and pure form, such as crystal MA, which is more readily available in Southeast Asia (mostly imported from China, Hong Kong, Japan, the Philippines, South Korea and Taiwan) [16,17]. Indeed, the primary sources of MA entering the Australian border include Canada and Southeast Asian countries [18]. AFP seizures[1] relate to illicit drug importations (i.e. illicit drugs collected at the Australian border) and therefore are not necessarily products derived from the smaller labs described above.

MA seized by the Australian Federal Police (AFP) is chemically profiled at the National Measurement institute (NMI). An AFP seizure can be composed of more than one batch. If these batches are visually different from one another, they are analysed separately. The seizure is divided into subgroups according to the observation and results obtained using the physical characteristics (e.g. colour, form, shape, diameter, weight, packaging, etc.) and presumptive test results. For instance, if all the bags of powder/tablets/liquid look similar (visually), have the same physical characteristics and have consistent presumptive test results, they are gathered in a subgroup. A sampling procedure is then used at the AFP to select samples from each subgroup for further analysis to ensure that the selected samples are representative of the subgroups and thus the whole seizure.

A number of analytical techniques are used at NMI to chemically profile MA specimens. These methods are summarised in Table 1.

Chemical profiling data are used by the AFP to obtain information about the manufacturing processes, precursors used, detection of new cutting agents and to confirm or refute a connection between cases previously detected using circumstantial information. It was demonstrated in a previous study that MA chemical profiling data have the potential to be used systematically to obtain links between seizures [14]. Illicit drug manufacture is typically a batch production process. Variations between impurity profiles will occur as production conditions may not be reproduced exactly each time (i.e. inter-batch variation). Single batch variations might also be observed due to inhomogeneity of the product (i.e. intra-batch variation). A seizure might be composed of more than one batch. Successful classification of specimens is thus only possible if inter-batch variations are greater than intra-batch variations in a laboratory and the intra-laboratory variations are lower than the inter-laboratory variations [21]. According to the literature, with synthetic drugs intra-batch

[1] In this article, a seizure is defined as the entire quantity of illicit drug sequestered at the one location and time. A seizure is made of specimens (i.e. units of the seizure). Following a sampling procedure, units that are representative of the seizure are called samples [3].