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The profiling of MDMA tablets: A study of the combination of physical characteristics and organic impurities as sources of information

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ABSTRACT

The profiling of MDMA tablets can be carried out using different sets of characteristics. The first type of measurements performed on MDMA tablets are physical characteristics (i.e. post-tabletting characteristics). They yield preliminary profiling data that may be valuable in a first stage for investigation purposes. However organic impurities (i.e. pre-tabletting characteristics) are generally considered to bring more reliable information, particularly for presentation of evidence in court. This work aimed therefore at evaluating the added value of combining pre-tabletting characteristics and post-tabletting characteristics of seized MDMA tablets. In approximately half of the investigated cases, the post-tabletting links were confirmed with organic impurities analyses. In the remaining cases, post-tabletting batches (post-TBs) were divided in several pre-tabletting batches (pre-TBs), thus supporting the hypothesis that several production batches of MDMA powder (pre-TBs) were used to produce one single post-TB (i.e. tablets having the same shape, diameter, thickness, weight and score; but different organic impurities composition). In view of the obtained results, the hypotheses were discussed through illustrating examples. In conclusion, both sets of characteristics were found relevant alone and combined together. They actually provide distinct information about MDMA illicit production and trafficking.

1. Introduction

When ecstasy tablets are seized in Switzerland, the first legal step is to identify the illicit active substance(s) [1]. Beyond this legal requirement, other information extracted from the seizures (i.e. physical characteristics and chemical composition of the tablets) are valuable to gain intelligence on drug production and trafficking and may help ongoing police investigations [2–4]. Drug profiling is defined as the extraction of chosen physical and/or chemical characteristics from the samples and their use as intelligence in the fight against illegal drug trafficking [5]. Different information can be obtained, depending on the chosen set of characteristics (i.e. profile). It is generally assumed that seized tablets having corresponding characteristics come from the same production batch, while tablets showing different characteristics come from different batches [3,5].

The different stages of illicit production of 3,4-methylenedioxymethamphetamine (MDMA) tablets yield a set of physical and chemical characteristics to the end products (i.e. tablets) [3]. Two main production steps can be distinguished:

(1) The synthesis of the active substance, which is characterised by its organic composition, and the cutting agents [6,7]; this mixed powder was defined in a previous study as a *pre-tabletting batch* (pre-TB) [3].
(2) The compression of this mixture into tablets; a set of tablets produced by a specific tabletting machine with given settings was previously defined as a *post-tabletting batch* (post-TB) [4].

These two different processes, synthesis and tabletting, may be done in separate locations and should therefore be considered separately when profiling is carried out. After tabletting, the samples undergo no further change until consumption or seizure by police forces.

Different synthesis routes are described in literature [8]. Several papers describe the determination of the synthesis route based on organic impurities [9–14].

When tablets are seized, the physical characteristics are examined because they are relatively straightforward to measure and do not require advanced instrumentation. It was demonstrated that physical characteristics highlight links between MDMA samples coming from the same post-TB [4]. This information is then communicated to the police services. In an operational perspective, samples showing identical profiles may highlight connections between separate cases and provide links between ongoing inquiries [15,16]. However, for court purposes,

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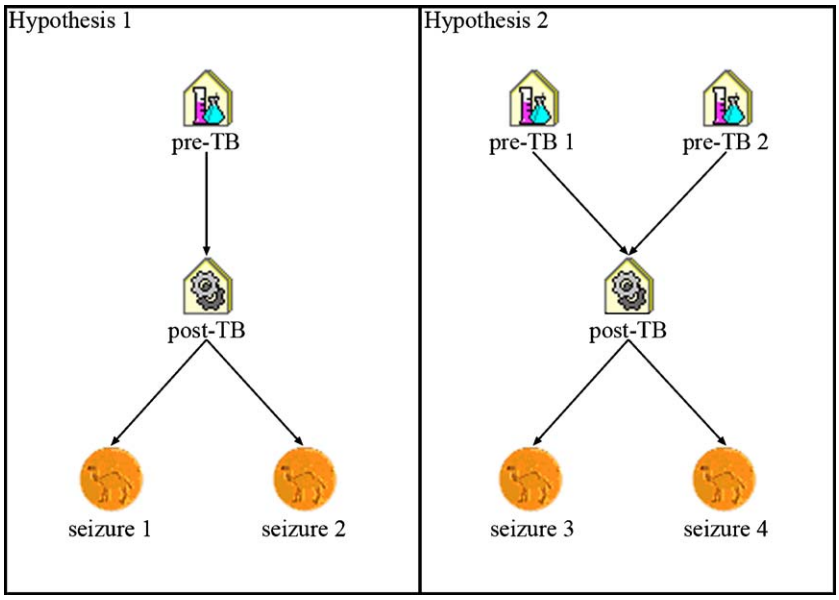

Fig. 1. Tablets coming from the same *post-tabletting batch* (post-TB; i.e. corresponding physical characteristics profiles) may come from (1) the same *pre-tabletting batch* (pre-TB; i.e. corresponding organic impurities profiles) or (2) different pre-TBs (i.e. different organic impurities profiles).

physical characteristics are generally not considered sufficient enough to provide evidence of a link between seizures. Organic impurities profiling is regarded as a discriminant tool to establish links between seized tablets coming from the same pre-TB. However, no information on the combination of pre-TBs and post-TBs has been yet published. Generally, only the combination of both sets of characteristics is accepted to present a link between seized tablets in court.

This paper aims to investigate the correlation of profiling information contained in organic composition and physical characteristics. For that purpose, tablets showing physical characteristics lead the authors to infer that they came from the same post-TB and were thus selected. Various GC–MS methods have been developed to analyse organic impurities [6,13,14,17,18]. In the present work the selected tablets were analysed with an analytical method developed by van Deursen et al. [7].

Two alternative hypotheses were thus investigated (Fig. 1):

(1) One pre-TB is used to manufacture one batch of post-TB. Post-TB links are then confirmed by pre-TB links.
(2) Several pre-TBs are used to manufacture one post-TB (simultaneously on identical machines with same settings, or in sequence on the same machine). Different pre-TBs are highlighted among one post-TB.

2. Materials and methods

2.1. Sampling

Two series of MDMA samples were selected for this work. The first series of tablets (53 seizures) were examined and classified by Zingg [2]. The classification was done considering all recorded physical characteristics: logo, shape (back, front, edge) presence of a score, colour, diameter, thickness and weight. 8 post-TBs have been determined (Table 1). Each group corresponds to one post-TB, except the Ferrari, divided in three post-TBs, according to slight differences in the colour and logo details.

The second series of tablets (67 seizures) were classified in post-TBs according to the characteristics used in a previous European project [4], i.e. the shape (front), diameter, thickness, weight and presence of a score on the tablet's surface. This restricted set of characteristics have been selected mainly due to their inter laboratory comparability. Other characteristics (colour, colour variance, shape back and edge, or logo) were not considered reliable between different operators. Therefore, tablets with different logos and colours may be grouped in the same post-TB (Table 2).

2.2. Organic composition

All samples were analysed using a harmonised method developed by van Deursen et al. [7] on an Agilent Gas Chromatograph (6890)–Mass Spectrometer (5973). One tablet per seizure was analysed. The quality of the chromatographic system was checked using the criteria defined in the European project 'Collaborative Harmonisation of Methods for Profiling of Amphetamine Type Stimulants' (CHAMP) funded by the 6th framework programme of the European Commission (contract no. 502126) [3]. The 8 impurities considered in this work (Table 3) were chosen for their good reproducibility and high discriminating power according to published results of the CHAMP project.

2.3. Data processing and statistics

The selected ions responses in the chromatograms were integrated for each targeted impurity. Peak areas were normalized to the sum of the 8 selected impurities and the square root was performed in order to reduce the influence of larger peaks. This pre-treated data represented organic impurities profiles used for further processing and comparisons [3]. Excel® was used for treating raw data from the chromatograms.

Table 1
First series of 8 post-TBs [2]. The shapes of the tablets were the same for all the seizures belonging to one post-TB.

No.	Group (logo)	Samples	Colour	Score	Diameter [mm]	Thickness [mm]	Weight [mg]	Post-TB
1	Ferrari	F1–2	White	No	9.1 ± 0.1	3.9 ± 0.1	306 ± 7	Ferrari_1
2		F3–9	White	No	9.1 ± 0.1	3.7 ± 0.3	293 ± 22	Ferrari_2
3		F10–12	White	No	9.1 ± 0.1	4.0 ± 0.1	297 ± 12	Ferrari_3
4	Oval	O1–O9	Beige	Yes	12.8 ± 0.1	4.6 ± 0.1	308 ± 8	Oval
5	Blue	B1–12	Blue	No	8.1 ± 0.1	3.9 ± 0.3	210 ± 23	Blue
6	Mitsubishi	M1–4	Beige-white	No	9.1 ± 0.1	4.6 ± 0.1	341 ± 17	Mitsubishi
7	Dromedary	D1–9	Yellow	No	8.1 ± 0.1	3.8 ± 0.1	237 ± 11	Dromedary
8	Twins	T1–7	Beige	Yes	9.0 ± 0.1	4.5 ± 0.2	305 ± 10	Twins