

## Original papers

QJM

# Purchasing ‘legal highs’ on the Internet—is there consistency in what you get?

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## Summary

**Background:** The supply of recreational drugs has changed and users increasingly buy ‘legal highs’ over the Internet. Use of these is common and there is a potential for significant toxicity associated with their use.

**Aim:** To determine the content of legal highs available for purchase in the UK and whether the content of these remains consistent.

**Methods:** Twenty-six legal highs were purchased monthly from five different Internet sites over 6 months. These were analysed to determine the drugs in the products and whether there were any changes in their content over this time period.

**Results:** All products were supplied initially, but there was a decline in supply of products month by month. The following drug classes were detected: piperazines, cathinones, caffeine/ephedrine or products in which no psychoactive drugs were detected.

Of the products supplied on more than one occasion, 15 (75%) contained the same compounds on each occasion. In three products there was a change in the piperazine detected, with 1-benzylpiperazine being substituted for 1-methyl-4-benzylpiperazine or vice versa. In two other products there was a cathinone [4-fluorophenylpiperazine (pFPP) or 3-fluoromethcathinone (3FMC)] detected in products purchased in Month 1 that was not present in the products purchased in subsequent months.

**Conclusions:** Whilst there was no variation in the composition of most legal highs supplied over 6 month, there was significant variation in the piperazine or cathinone content of one quarter of the products. This variation could be of clinical significance as the cathinone and piperazine products can be associated with significant toxicity.

## Introduction

The supply of recreational drugs to users has changed over recent years, with increasing use of the

Internet to source recreational drugs and/or purchase of ‘legal highs’ from high street head shops.<sup>1,2</sup> These changes have been associated with a change in the types of compounds being used as

recreational drugs, with increased use of novel compounds such as cathinones, piperazines and synthetic cannabinoid receptor agonists ('spice').<sup>3</sup> A recent survey of over 2000 UK clubbers showed that use of these compounds is common—26% of respondents to a website survey had used 1-benzylpiperazine previously and 41.7% had used the cathinone, mephedrone.<sup>3</sup> There is the misconception that these compounds are 'safe' as some of them are sold legally and are not controlled under the UK Misuse of Drugs Act (1971). However, there are numerous case reports of toxicity similar to that seen with classical recreational drugs in individuals using these legal highs.<sup>4–10</sup> As a result of the toxicity associated with some of these compounds, the UK Misuse of Drugs Act (1971) was amended at the end of 2009, to control a number of piperazine derivatives as class C compounds and synthetic cannabinoid receptor agonists as class B compounds.<sup>11</sup>

Previous studies have analysed drugs removed from individuals entering nightclubs or large music festivals, by security staff in 'drug amnesty bins'.<sup>12,13</sup> Analysis of drugs at the turn of the century showed that tablets from both London and Manchester contained MDMA ('ecstasy') in >94 and >84% of tablets, respectively. More recent studies have analysed drugs removed from/left by individuals presenting to the Emergency Department with acute recreational drug toxicity.<sup>14</sup> These have shown that the pattern of drugs used appears to have changed, with the detection of a number of novel recreational drugs, including the piperazines and cathinones.

The packaging of these drugs bought on the high street or through the Internet often does not provide any information to the user on the active constituents, and where this is provided it is usually very limited and often inaccurate.<sup>15</sup> There have been no previous published studies demonstrating whether the contents of the preparations supplied via the Internet remain consistent over time, or if the constituents change over time.

## Materials and methods

Five different Internet sites well-known for the provision of legal highs for delivery to the UK were identified by JR/DW/PD/SD, and a list of 26 legal highs from these sites was compiled. The Internet sites used (and number of products from each site) were: AM-HI-CO ([www.am-hi-co.com](http://www.am-hi-co.com)) ( $n=7$ ), BioRepublik ([www.biorepublik.com](http://www.biorepublik.com)) ( $n=7$ ), Everyonedoesit ([www.everyonedoesit.co.uk](http://www.everyonedoesit.co.uk)) ( $n=6$ ), Red Eyed Frog ([www.redeyedfrog.co.uk](http://www.redeyedfrog.co.uk)) ( $n=5$ ) and Salvia Dee ([www.salviadee.com](http://www.salviadee.com)) ( $n=1$ ). We attempted to purchase these legal highs once a month, on the same date each month, using

a company debit card for delivery to a UK postal address.

Upon delivery, information on the exact product(s) received, along with details of any missing purchases, was recorded. Samples were retained within their original packaging for future reference, and stored within a Home Office approved and licensed drug analysis laboratory. Samples were subsequently qualitatively analysed in chronological order of receipt by a previously described gas chromatographic assay with mass spectrometric detection (GC-MS).<sup>12</sup> Where standards were not available commercially, particularly for the piperazines and cathinones they were synthesized in house.<sup>16</sup>

The analytical data were collated to determine (i) the initial constituents of the legal highs purchased; (ii) whether there was any association between the cost of an individual product and the likely constituents of that product; and (iii) whether the constituents of individual purchases changed over time.

## Results

### Constituents of the legal highs purchased at baseline

All 26 legal highs selected from the five different Internet supplier sites were delivered in the first month (January 2009). The names of the legal highs and the constituents detected on analysis are summarized in Table 1. The substances detected fell broadly into the following drug classes: piperazines, cathinones, caffeine/ephedrine or no psychoactive drugs detected; the number of legal high products in each of these classes is summarized in Figure 1.

### Price of legal high as indicator of active ingredients

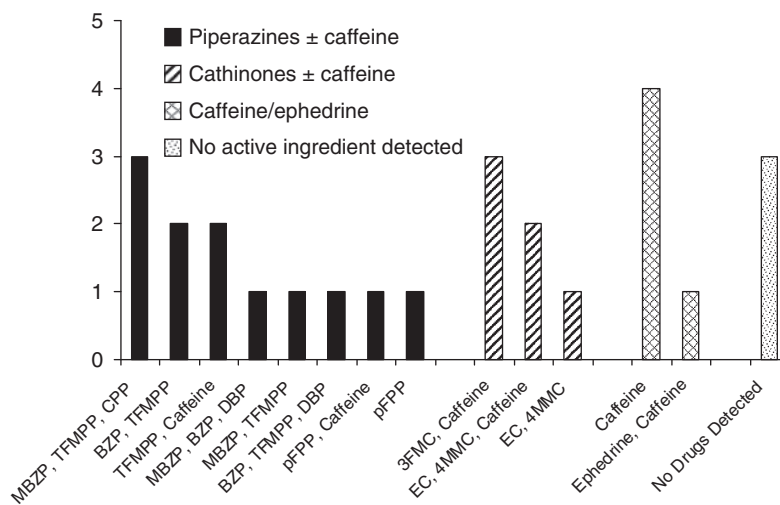
The cost of individual products ranged from £5.50 to £11.99 per pack and each pack contained between one and six tablets or capsules. In addition, the legal highs purchased from Biorepublik were supplied as 18 capsules for a multi-pack price of £99. For the products that contained an active drug ingredient, when the cost per individual capsule or tablet was calculated, based on the number of tablets in each pack, there appeared to be an association between the cost per tablet/capsule and the active drug class detected (Table 2).

Interestingly, of the three the purchases where no psychoactive drug was detected, the mean price was equivalent to £4.33 per tablet/capsule. This price is comparable to the mean price per tablet/capsule for purchases containing either cathinones or piperazines.

**Table 1** Summary of the 26 'legal highs' purchased initially and the active ingredients detected on analysis

Internet supplier	Legal high name	Active ingredients detected
AM-HI-CO	Head rush	MBZP, TFMPP, CPP
	Xtacy	MBZP, TFMPP, CPP
	Doves original	BZP, TFMPP
	XXX strong as hell	BZP, TFMPP, DBP
	Exotic super strong	BZP, TFMPP
	Exotic super extra strength	MBZP, BZP, DBP
	Space trips	MBZP, TFMPP
BioRepublik	2× pink capsules	EC, 4MMC
	6× white capsules	3FMC, Caffeine
	2× yellow capsules	3FMC, Caffeine
	2× red capsules	EC, 4MMC, Caffeine
	2× brown/white capsules	Caffeine
	2× yellow/white capsules	3FMC, Caffeine
	2× blue/white capsules	EC, 4MMC, Caffeine
Everyonedoesit	Giggle	pFPP
	Pure bliss	Caffeine
	Xtacy	ND
	Party on	Caffeine
	Rize 2 the occasion	ND
	Cockstar	ND
Red eyed frog	Hummer energy pills	Caffeine
	Loved up retopills	pFPP, Caffeine
	Summer fusion elevate	EPHDERINE, Caffeine
	Cherries retopills	TFMPP, Caffeine
	Super E retopills	TFMPP, Caffeine
Salivia Dee	Diablos XXX strong as hell	MBZP, TFMPP, CPP

MBZP: 1-methyl-4-benzylpiperazine; TFMPP: 1-[3-(trifluoromethyl)phenyl]piperazine; CPP: chlorophenylpiperazine; BZP: 1-benzylpiperazine; DBP: 1,4-dibenzylpiperazine; EC: ethcathinone; 4MMC: 4-methylmethcathinone; 3FMC: 3-fluoromethcathinone; pFPP: 4-fluorophenylpiperazine; ND: no psychoactive drugs detected.



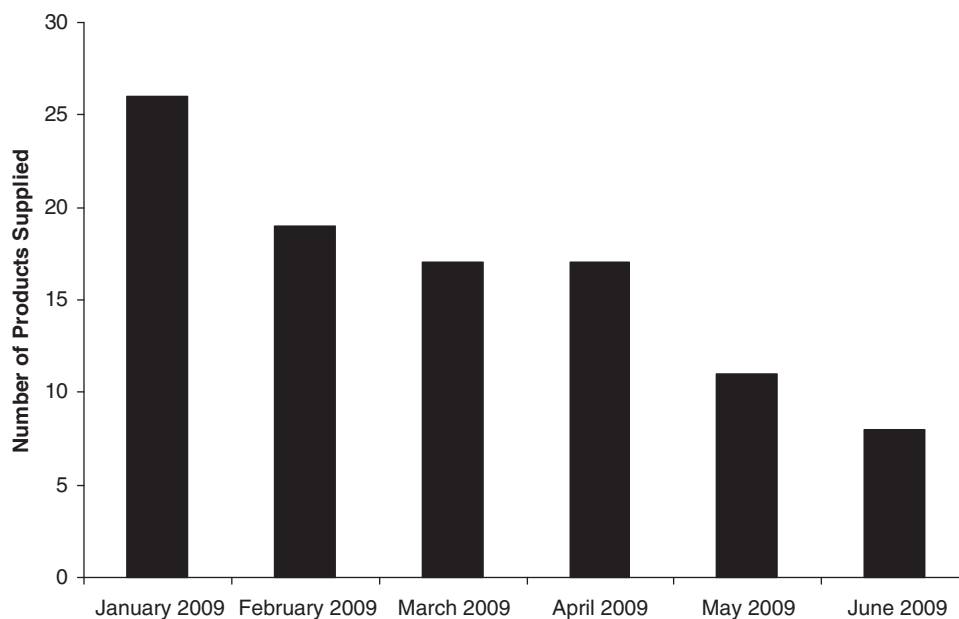
**Figure 1.** Breakdown of active ingredients detected based on drug class: Piperazines ± caffeine, cathinones ± caffeine, caffeine/ephedrine and no active ingredient detected. MBZP: 1-methyl-4-benzylpiperazine; TFMPP: 1-[3-(trifluoromethyl)phenyl]piperazine; CPP: chlorophenylpiperazine; BZP: 1-benzylpiperazine; DBP: 1,4-dibenzylpiperazine; EC: ethcathinone; 4MMC: 4-methylmethcathinone; 3FMC: 3-fluoromethcathinone; pFPP: 4-fluorophenylpiperazine).

## Consistency of contents and products supplied over 6 months

The number of products that were purchased and supplied each month is shown in Figure 2, which demonstrates that there was a steady decline in the number of products supplied over the 6-month period. None of the products purchased from 'everyonedoesit' were available for purchase or supply after they had been purchased in Month 1. The 20 products that were purchased and supplied on more than one occasion during the study contained the same active ingredient(s) detected in Month 1 as on subsequent analyses in 15 (75%) of products. Each supplier had one or more legal high in which there was a variation in content. In three of these, there was variation in the piperazines detected on analysis, with 1-benzylpiperazine being substituted for 1-methyl-4-benzylpiperazine and vice-versa. In addition, there was one product, which in Months 1, 2, 4, 5 and 6 contained both caffeine and 4-fluorophenylpiperazine (pFPP), but contained

**Table 2** Comparison of price per tablet/capsule and the active drug class detected for purchases in Month 1

Active drug class detected	Mean ( $\pm$ SD) cost per tablet/capsule (£)	Range of cost per tablet/capsule (£)
Cathinones	5.50 $\pm$ 0.00	5.50
Piperazines	4.62 $\pm$ 0.86	3.30–5.85
Caffeine/Ephedrine	2.97 $\pm$ 0.44	2.50–3.40



**Figure 2.** Number of 'legal highs' purchased and supplied by month during the study.

only caffeine in Month 3. The final product in which there was a variation in content contained 3-fluoromethcathinone (3FMC) and caffeine in Months 1–4, was not supplied in Month 5 and contained only caffeine in Month 6.

## Discussion

Legal highs such as those purchased in this study are widely used in the UK and elsewhere in Europe. A recent survey of over 2000 UK clubbers showed that 26% had used 1-benzylpiperazine previously and 41.7% had used mephedrone.<sup>3</sup>

In this study, the most commonly seen active drug class in the tablets purchased were piperazines, followed by the cathinones; caffeine/ephedrine were also commonly present. We have shown that although there was no variation in the content of most legal highs supplied over the 6-month period, there was significant variation in one quarter of the products. There is the potential for significant toxicity associated with piperazine and cathinone drugs<sup>1,4,5</sup> and so the variation in the active drug in these compounds is important enough to be of clinical relevance. For individuals purchasing these drugs, the name of the product is insufficient information for buyers to be confident as to their exact content.

During this study it was relatively easy to purchase a number of legal highs from different Internet suppliers. However, there were months when not all the products were available for

purchase. In particular, the products from 'everyonedoesit' were not available for purchase after the first month. It is difficult to determine what an individual user of legal highs will do when they are unable to purchase their 'usual' legal high. They may decide to either purchase alternative products recommended on the same site or attempt to purchase the product from a different Internet site. There is then the risk that individuals will be exposed to different active drugs than those that they may be used to. Potentially, this could increase the risk of unwanted effects or lead to acute toxicity due to a difference in the relative amounts of active drug ingredient(s). This study was a qualitative study and therefore we did not assess the relative concentration(s) of the active ingredients; therefore, there is the potential that changes in the concentration(s) of constituents could put individuals at risk of increased acute toxicity.

The price per tablet/capsule was a predictor of the likely active ingredient(s) within the tablets/capsules, with products costing >£5 per tablet/capsule more likely to contain cathinones, ~£4–5 per tablet/capsule likely to contain piperazines and those costing <£4 likely to contain either caffeine/ephedrine or no active drug. However, given that there is significant variation in the relationship between price per tablet/capsule and the active drug ingredients detected, it is unlikely that an individual would be able to predict precisely which compound they will receive based only on purchase price alone.

At the time this study was undertaken, all of the active drug classes detected were not controlled by the UK Misuse of Drugs Act (1971). However, subsequently, the piperazines were controlled in the UK on the 23 December 2009 under this legislation.<sup>11</sup> It is likely that the active drugs detected in the products purchased as part of this study will have changed following this change in the UK control of the piperazines. The suppliers may either withdraw these products from sale or change the active ingredients so that they remain legal for sale in the UK. Further work is needed on further purchases of the products shown to contain piperazines in this study, to determine if they are still available and/or whether the active ingredients have changed, to determine the effectiveness of the changes in the UK legislation.

*Conflict of interest:* D.M.W and P.I.D. have acted as scientific advisors to the UK Advisory Council on the Misuse of Drugs (ACMD) and the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA).

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