Analysis of the Volatile Alkyl Nitrites

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Introduction

The volatile nitrite inhalants, commonly known as poppers, refer to *iso*-propyl, butyl, *iso*-butyl, *tert*-butyl and amyl nitrite. They are highly volatile, colourless to pale yellow liquids, that are commercially available and sold as "room odourisers" but clearly intended for drug use. The preparations are sold at festivals, dance clubs, "head" shops and even high street shops. They can also be obtained via the Internet under a variety of trade names, shown in figure 1.

Poppers have been used recreationally on the dance scene[1] for a variety of reasons; for a euphoric "high", to promote abandonment on the dance floor and for the enhancement of sexual experiences[2]. Apart from being sold as room odourisers, the low molecular weight alkyl nitrites are used as intermediates in anti-freeze preparations and perfumes[3]. Amyl nitrite was used in medicine for the relief of angina pectoris[2] and in the treatment of cyanide poisoning[4].

We analysed poppers collected from drug amnesty bins and bought from festivals over two time periods spanning the classification of isobutyl nitrite as a Schedule 2 carcinogenic substance in Category 2, Regulation 5 of the Dangerous substances and Preparations (Safety) Regulations 2006[6]. This was enacted on 24th August 2007.

Figure 1: Poppers sold under a variety of trade names including a "new and improved" version purchased at the Gastonbury Festival 2008, clearly labelled as containing *iso*-propyl nitrite.

Trade names

Buzz Aroma
Rave Room
Pure Gold
Liquid Gold
Bang Aroma
Original Gold Aroma
Heavy Duty Bolt
Liquid Incense

Toxic and carcinogenic effects

Alkyl nitrites are potent vasodilators. Inhalation results in dilation of blood vessels around the heart, causing decreased blood pressure and increased heart rate. Profound hypotension has been reported, as well as dizziness, headache and fatigue[2]. Oral ingestion of alkyl nitrites may cause severe methaemoglobinemia and has been associated with fatalities[2,5]. Alkyl nitrites are rapidly hydrolysed *in vivo* to the corresponding alcohol and nitrite ion[3]. Nitrites are potential carcinogens due to their ability to react with amines and amides in an acid medium to form *n*-nitrosamines and *n*-nitrosamides. Nitrosamines are highly toxic and carcinogenic to many organs[2].

Few studies have compared the toxic and carcinogenic potential of the different alkyl nitrites. However, an inhalation study on rats to determine the lethal doses of *n*-propyl, butyl, *iso*-butyl and *iso*-amyl nitrite showed LC_{50} to be 330ppm, 420ppm, 777ppm and 716ppm respectively[7]. This suggests that the more volatile *n*-propyl nitrite may be more toxic than *iso*-butyl nitrite; the common component of poppers. Unfortunately this study did not include *iso*-propyl nitrite.

Experimental

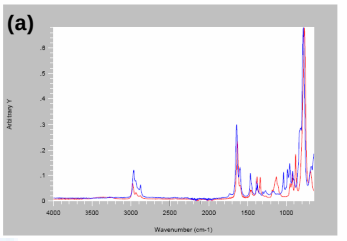
Materials: *Iso*-butyl nitrite (95%) reference standard was purchased from Sigma Aldrich (UK). *Iso*-propyl nitrite reference standard was prepared in-house from HPLC grade *iso*-propanol (99.9%), conc sulphuric acid (BDH) and sodium nitrite (97%) (Sigma Aldrich). Commercially sold poppers were obtained from 2006 and 2008 drug amnesty bin seizures.

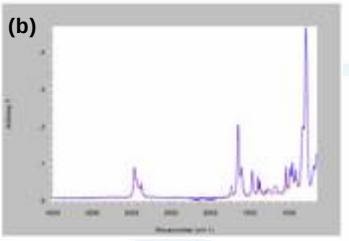
Instruments: IR: A Perkin Elmer model 157 dispersive infra red spectrophotometer with a 70° NaCl prism was used, scanning in the range 4000 to 650cm^{-1}. GC-FID: A Shimadzu 2014 GC fitted with a dual Elite BAC columns and flame ionisation detection were utilised for comparison data. 100µL of headspace was injected in split mode (20:1) with the injector maintained at 200°C. Helium carrier gas had a flow rate of 3.47ml/min. The oven temperature was held at 45°C for 3.5min and ramped at 20°C/min to 100°C and held for 5min. Manual injections were made using a Hamilton 100µL glass barrel syringe.

Procedure: 10µL of the alkyl nitrite standard or popper liquid were transferred to 20mL headspace glass vials and capped. Sample was heated in oven at 60°C for 5mins before injection of headspace sample.

Results

All samples (n=46) were shown to contain the stated ingredient; either *iso*-butyl or *iso*-propyl nitrite. Bottles obtained in 2006 (n=15), prior to the ban of *iso*-butyl nitrite, were all found to contain *iso*-butyl nitrite by IR analysis. Bottles obtained after the ban in 2008 (n=31), only 38.7% were found to contain *iso*-butyl nitrite whilst the remaining 61.3% contained *iso*-propyl nitrite. GC-FID analysis showed two peaks present for each liquid; assumed to be the nitrite and corresponding alcohol. Due to a constant shift in retention time on 6 repeated injections for each standard, GC-FID results could not be relied upon.





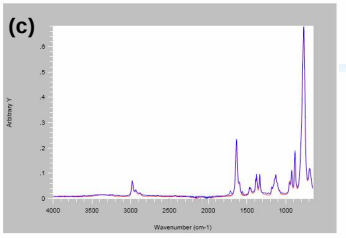


Figure 2 : Overlaid spectra of **(a)** *iso*-butyl nitrite (blue) and *iso*-propyl nitrite (red) standards. Distinguishing peaks: *iso*-butyl nitrite 1049, 996 & 965cm^{-1}; *Iso*-propyl nitrite 1343, 1138 & 891cm^{-1}. **(b)** *Iso*-butyl nitrite standard (red) and "Pure Gold" *iso*-butyl nitrite sample (blue). **(c)** *iso*-propyl nitrite standard (red) and "New Formula Pure Gold" *iso*-propyl nitrite sample (blue).

Discussion

Iso-propyl nitrite could potentially be as harmful as *iso*-butyl nitrite; further research is required to support this. It is more volatile, and possibly more toxic and as carcinogenic as its counterpart. This small scale study shows its use as a replacement for *iso*-butyl nitrite in commercially sold poppers, since a change in legislation. This demonstrates that this lucrative market has responded to changes to legislation.

Conclusions

It is predicted that the sale and use of the "new formula" poppers containing *iso*-propyl nitrite will continue to increase unless toxicological data is gained to support further regulation.

References

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