Detecting 'poppers' - Analysis of alkyl nitrites and their corresponding alcohols by HS-GC/FID



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Introduction / Aims

Alkyl nitrites, also known as 'poppers', have a long history as medical drugs for treatment of cardiovascular problems and enhancer of sexual performance. 'Poppers' are mostly used as inhalants due to their volatility, and fatalities are rare. Typical effects include vasodilation, hypotension, methemoglobinemia and reduction of smooth muscle tonus including the anal sphincter.

Although fatalities are rare it is useful to have a validated method just in case. The method should be able to detect alkyl nitrites (2methylbutyl, amyl, isoamyl, isobutyl, isopropyl and n-butyl nitrite) and to quantitate the corresponding alcohols and acetone in both, liquids potentially containing alkyl nitrites and body fluids. The practical approach was the further development of an already existing analytical method for congener alcohols with HS-GC/FID.

Additionally we started a screening of poppers products and tested the nitrates for sensitivity to hydrolysis.

Method

Analysis was performed on a Clarus gas chromatograph using a capillary column (RTX[®]-502.2, Proprietary Crossbond[®] diphenyl/dimethyl polysiloxane phase, Restek, 60 m, 0.53 mm ID, 3 μm film thickness) fitted with a headspace autosampler and a flame ionisation detector. Carrier gas was H₂ at a flow rate of 45 mL/min. A split flow of 10 mL/min was applied for body fluids, for analyzing pure nitrites and 'poppers' products split flow was adjusted. Sensitivity of the nitrites to hydrolysis was investigated.

All common alkyl nitrites and their corresponding alcohols can be detected by the described simple HS-GC-FID method. The method was successfully applied to various 'poppers' products and in post-mortem toxicology.

LLOQs for all alcohols serum ranged from 0.02 to 0.05 mg/L, 0.24 mg/L for acetone and 0.22 mg/L for methanol.

Sufficient chromatographic separation of all analytes was achieved. Specificity was tested with ten volatile compounds and allowed for identification by retention time only.

Methode		GC/FID						autosampler						
	oven/inlets				carrier			detector		syringe	transfer	oven		
	injector	gradient		time	ramp		flow	temp	Gases					
		rate	temp	hold	min	rate	set-	Hold	mL/min	°C	mL/min			
		°C/min	°C	min		kPa/min	point	min						
							kPa							
Poppers	250 °C	0	35	5.00	18.86	0	40	999	10/500	250 °C	H ₂ : 45	60 °C	60 °C	35 °C
		8	105	0.00							Air: 450			
		45	200	2.00										





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Limits			number of nitrites found per
in serum	LLOQ	LOD	poppers product
1-butanol	0.05 mg/L	0.02 mg/L	2 %
1-propanol	0.04 mg/L	0.01 mg/L	
2-butanol	0.03 mg/L	0.01 mg/L	9 %
2-methyl-1-butanol	0.05 mg/L	0.01 mg/L	
3-methyl-1-butanol	0.05 mg/L	0.02 mg/L	■ 4 nitrites
acetone	0.24 mg/L	0.07 mg/L	3 nitrites
isobutanol	0.05 mg/L	0.01 mg/L	55% 2 nitrites $34%$
isopropanol	0.05 mg/L	0.02 mg/L	1 nitrite
2-butanon	0.05 mg/L	0.02 mg/L	
methanol	0.22 mg/L	0.06 mg/L	
1-pentanol	0.02 mg/L	0.01 mg/L	



Consistency of declared content with analytical results

wrong: questionable:	the declared nitrite was not found in the product declaration stated pentylnitrite, isopentylnitrite was found
underreported:	the declared nitrite was found in the product besides one or more additional nitrites
pentyl-mixture:	declaration stated only pentylnitrite, n-pentyl- and isopentylnitrite were found
correct:	accordance of declaration and analytical result





2-methyl-2-propanol	C₄H ₉ OH	4.50 min
1-propanol	C ₃ H ₇ OH	5.83 min
isobutyInitrite	$C_4H_9NO_2$	6.50 min
2-butanol	C ₄ H ₉ OH	7.54 min
2-butanon	C_4H_8O	8.01 min
1-butylnitrite	$C_4H_9NO_2$	8.25 min
ethylacetat	$C_4H_8O_2$	8.50 min
isobutanol	C ₄ H ₉ OH	8.71 min
1-butanol	C ₄ H ₉ OH	10.31 min
2-methylbutylnitrite	$C_5H_{11}NO_2$	10.45 min
isopentylnitrite	$C_5H_{11}NO_2$	10.52 min
amylnitrite	$C_5H_{11}NO_2$	11.85 min
isoamylalcohol	$C_5H_{11}OH$	12.95 min
2-methyl-1-butanol	$C_5H_{11}OH$	13.09 min
1-pentanol	$C_5H_{11}OH$	14.13 min
N		

Testing hydrolysis

Sensitivity to hydrolysis was tested by adding water to the samples stored at room temperature and analysis after 7 and 23 days for pure nitrites, and after 5, 11 and 33 days for selected poppers products.







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