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Ethylcarbamate (Urethane) in Distilled Alcoholic Beverages

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Ethylcarbamate Testing

Ethylcarbamate (Urethane, C2H5OCONH2) is a known genotoxic carcinogen that commonly exists in fermented food and beverages as it can be generated during the fermentation/distillation process. Ethylcarbamate has been detected in various alcoholic beverages that have been fermented, as well as other products including bread, yoghurt, cheese, soy sauce and vinegar. Primary production of Ethylcarbamate arises when cyanate reacts with ethanol to produce carbamate esters.

Ethylcarbamate was re-classified as a 2A carcinogen by the IARC (International Agency for Research on Cancer) in 2007 and is now regulated in many countries. Levels within food have comparably little effect of increasing chances of developing cancer, however when partnered with distilled alcoholic beverage consumption, the risk increases greatly. There are currently no standardised limits for maximum levels of Ethylcarbamate in the European Union (EU). Recommended maximum levels for Ethylcarbamate in alcoholic beverages are contained in Table 1, including USA, Canada, Czech Republic, France and Germany. EFSA (European Food Safety Authority) also noted that these levels needed to be monitored and reduced by manufacturers.

The Ellutia 800 series TEA was employed as it is the most sensitive detector for nitrosamines. It was used alongside the Ellutia 200 series Gas Chromatograph. The GC started the separation process of the sample. Its small footprint and low energy usage makes it a space and cost effective addition to the laboratory.

GC Conditions	
Injector Temperature:	250^{0}C
Carrier Gas Type:	Helium Constant Flow Splitless
Split Time:	0.5 min
Column Flow:	1.0 ml min^{-1}
Injection Volume:	1.0 µl
Column Type:	EL-WAX 30 m x 0.25 mm x 0.25 µm
Column Temperature Program	
Initial Temperature:	45^{0}C/1 min Hold Time
Temperature Ramp 1:	20^{0}C min^{-1}
Column Temperature 1:	130^{0}C/0 min Hold Time
Temperature Ramp 2:	12^{0}C min^{-1}
Column Temperature 2:	230^{0}C/1 min Hold Time
TEA Conditions	
Pyrolyser Temperature:	850^{0}C
Interface Temperature:	250^{0}C
Sensitivity:	250
Pump Type:	Edwards nXDS10i
Mode:	Nitrogen

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Table 1: Maximum permissible levels for Ethylcarbamate in alcoholic beverages (µg/l)

Country	Wine	Fortified Wine	Distilled Spirits	Saki	Fruit Brandy
USA	30	100	150	200	400
Canada	15	60			
Czech Republic	30	100[a]	150	200	400[b]
France			150		1000
Germany					800

[a] Fruity wines and liqueurs [b] Fruity distillates and fruity, mixed and other spirits. Table taken from The EFSA Journal (2007) 551, 1 – 44.

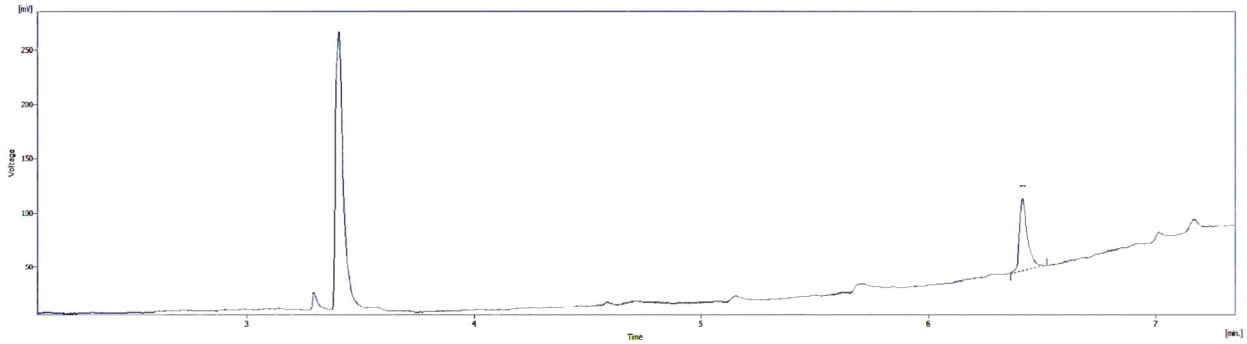

Figure 1. A chromatogram of a 1 µl injection of 1% solution of Ethylcarbamate, with a retention time of approximately 6.5 minutes.

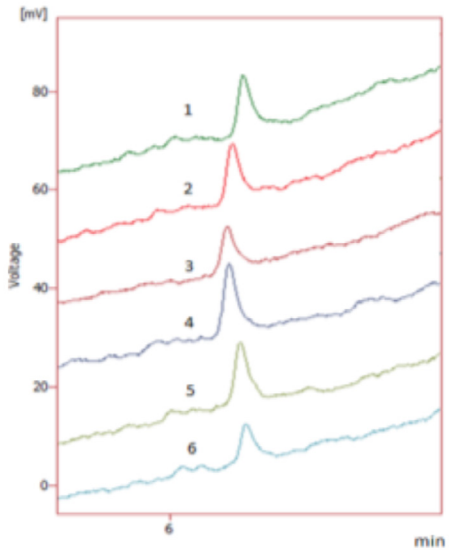

Figure 2. Chromatogram of five alcoholic beverages and a 100 ppb Ethylcarbamate standard.standard. Number in brackets relate to signal number in Figure 2.Ethylcarbamate, with a retention time of approximately 6.5 minutes.

	Area Response mV.s	ppb Calculated
25% Fruit Gin (1)	21.145	31.23
40% White Rum (2)	21.745	34.61
60% White Rum (3)	16.881	7.23
Cachaca (4)	29.005	75.46
Saki (5)	23.36	43.69
100ppb Standard (6)	16.681	n/a

Table 2. Results for each five samples and a 100ppb standard. Number in brackets relate

A variety of alcoholic beverages purchased within the UK were analysed for the presence of Ethylcarbamate. These alcoholic beverages were analysed on an Ellutia 200 GC followed by detection on an Ellutia 820 TEA working in Nitrogen detection mode. This mode of analysis detects Nitrogen containing compounds within a sample. The Ellutia 810/820 systems are able to analyse various Nitro or Nitroso compounds, utilising the selectivity available through Nitrogen or Nitroso modes. Nitrogen mode utilises the catalytic pyrolyser tube, Oxygen reactor and higher temperatures to detect nitrogen compounds. Results for various alcoholic beverages are shown in Figure 2.

Ordering Guide

Main Instruments	
TEA 820 - 230V	(Part no. 32000820)
Cold Trap Replacement (CTR)	(Part no. 32090001)
200 Seeries FID Gas Chromatograph	(Part no. 20500130)
Ellution Software - Single Instrument	(Part no. 23001001)
EL-WAX Capillary Column, 30 m x 0.25mm x 0.25µm	(Part no. 51100298)
Optional	
Ellutia EL3100A Automatic Liquid Autosampler - 15 position	(Part no. 30500011)
Ellutia EL3000A Automatic Liquid Sampler - 121 position	(Part no. 30500010)
Ellutia EL3200A Automatic Liquid Sampler - 209 position	(Part no. 30500012)
Autosampler Control Software	(Part no. 23001012)
Accessories	
2ml Vials	(Part no. 20511101)
2ml Vial Screw Caps	(Part no. 20511107)
1 µl Liquid Syringe	(Part no. 20511204)
Septa	(Part no. 51100298)

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