



# The methanol content of illicit alcoholic beverages seized in a low socio-economic area of Tel-Aviv: public health impact and policy implications

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## Abstract

**Aim** To identify the presence and concentration of methanol in illegal alcoholic beverages sold commercially in a low socio-economic area of Tel-Aviv. Additionally, we aim to assess if findings represent an existing risk for public health in the area.

**Subjects and methods** Ministry of Health Division of Enforcement and Inspection personnel carried out a series of inspections in grocery stores and kiosks in two adjacent neighborhoods of low socio-economic status: Neve Sha'anani and Hatikvah. Twenty-six samples of illicit drinks were identified, seized, and then analyzed for the presence and concentration of methanol.

**Results** Alcohol products seized were spirits labeled as vodka, brandy, arak and “scotch flavor” drinks, which contained an average of 36.608% volume of ethanol. Methanol was detected in 15 samples. Methanol concentration levels varied considerably, from 12 to 4534 g/hl. Data of hospital emergency department visits revealed that only nine cases of methanol toxicity were reported for years 2014–2017, and none of them by area hospitals.

**Conclusion** We identified the sale of alcoholic beverages with high methanol content in the disadvantaged areas of Tel-Aviv, though hospitalization data does not reveal a high prevalence of cases involving methanol toxicity. This may be related to misreporting or underreporting by area emergency rooms. Policy implications include the need to inform local shopkeepers and shop-owners on labeling regulations, and make information and health warnings accessible to the foreign-born population residing in the area. A larger sample is needed to determine the extent of the sale of methanol-containing illicit alcoholic beverages.

**Keywords** Methanol · Unrecorded alcohol · Counterfeit alcohol · Methanol toxicity · Alcohol policy · Surrogate alcohol

## Introduction

Alcohol drinking has a major impact on burden of disease, and is an important risk factor for chronic disease and injury (Rehm et al. 2009). Current trends show mortality associated with alcohol consumption fell by 12.6% from 2005 to 2015 (Wang et al. 2016). Nevertheless, in 2012, 5.9% of all deaths, and 5.1% of the global burden of disease as represented in

Disability-Adjusted Life Years (DALY) were attributed to alcohol consumption (World Health Organization 2014a). Disadvantaged populations of lower socio-economic status appear to be more at risk for alcohol associated disease and mortality (Probst et al. 2014). This may be partly attributed to consumption of illicit, substandard alcoholic beverages, due to their comparatively lower price (Rehm et al. 2010).

The toxicity of an alcoholic beverage depends largely on the presence of toxic substances at levels higher than those established in regulations (Lachenmeier and Rehm 2013). The quality of alcohol is particularly relevant when addressing the problem of unrecorded alcohol consumption, which consists of homemade alcohols and illegally produced or smuggled alcohol products, as well as surrogate alcohol not officially intended for human consumption (World Health Organization 2014b). The category of illegally produced alcohol includes those fraudulent products imitating known brands. These infringe upon the intellectual property of known brand holders and mislead consumers with regard to the nature and quality of these

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products (Organization for Economic Co-operation and Development 2008). The World Health Organization estimates that over a quarter of all alcohol consumption is unrecorded (World Health Organization 2014a). Illegally produced, fraudulent, and counterfeit products do not normally conform to guidelines on limits of toxic substances, and therefore are suspected of containing high levels of unwanted adulterants and substances such as methanol. Methanol consumption is mostly associated with punctual or regional mass poisoning outbreaks (World Health Organization 2014b). Large outbreaks have also been reported in some developing countries (Ahmad 2000; Rostrup et al. 2016), with mortality rates of up to 30% (World Health Organization 2014b).

Additional harmful substances have been occasionally identified in unrecorded alcohol. The carcinogenic and hepatotoxic substance ethyl-phtalate was found in samples of unrecorded alcohol from Lithuania (Leitz et al. 2009). Methanol, cyanide derivatives, and carbamates have been identified in samples of unrecorded alcohol from Brazil (Negri et al. 2015), and high levels of toxic metals were identified in local unrecorded distilled alcoholic beverages in China (Newman et al. 2017). Acetaldehyde and carbamates were also found at different levels in unrecorded alcohol samples from Lithuania and Hungary (Lachenmeier et al. 2008). Nevertheless, there is still no evidence that the consumption of adulterated unrecorded alcohol results in morbidity or mortality that exceeds that which results from ethanol consumption (Rehm et al. 2010, 2014).

Despite decreasing trends in alcohol consumption in the last decade, the prevalence of drinking remains high in Europe compared to other regions (World Health Organization 2014a), and correlates with high mortality rates and alcohol cirrhosis (Rehm et al. 2009; World Health Organization 2013). In comparison, alcohol consumption in Israel is among the lowest in OECD countries, at 2.6 liters per capita, despite a marked increase of 50% in alcohol consumption in the last 2 decades, accompanied by an overall decrease in drinking age (Sassi 2015). Moreover, there has been a dramatic rise in emergency department (ED) visits related to alcohol intoxication among adolescents aged 15–17, a rise of 226% among boys and 276% among girls between 2009 and 2013 (State Comptroller and Ombudsman 2016).

Amidst reports on rising alcohol consumption, health authorities in Israel also report an increase in unrecorded alcohol seizures, particularly of counterfeit and fraudulent products manufactured illegally and sold commercially (Ministry of Health 2017). Many seizures have occurred in the south Tel-Aviv area, around neighborhoods adjacent to the central bus station. The area around the central bus station is considered economically disadvantaged, as its population is ranked low, under tier 3 in the Israeli socio-economic cluster ranking, in which 10 is the highest ranking (Municipality of Tel Aviv 2013). It is estimated that over 60

% of the population of the central bus station area are young migrants from Africa, mainly from Eritrea and South Sudan, whose status is mostly irregular (Knesset Information and Research Center 2016). High unemployment among locals and migrants, poverty, and a relatively young population might constitute risk factors for the consumption of unrecorded alcohol fueled by growing availability. Unrecorded alcohol is commonly cheaper than recorded alcohol (Rehm et al. 2014), making it more accessible to the local population. While the central bus station area in Tel-Aviv represents a location where the sale of unrecorded alcoholic beverages appears to be prevalent, the effects on public health are not evident.

The purpose of this study is to determine the presence of methanol in seized samples of illegal alcoholic beverages. Moreover, we aim to assess if findings represent an existing risk for public health in the area, by checking if methanol-toxicity ED visit reports were at an increase in the area during the time seizures were carried-out, and 3 years prior to them.

## Materials and methods

Twenty-six (26) samples identified as illegal alcoholic bottled beverages were seized at shops, convenience stores and kiosks in the three main commercial streets of Neve Sha'an and the two main commercial streets of the adjacent neighborhood of Schunat Hatikvah in the south of Tel-Aviv. All samples were confiscated during four separate enforcement operations carried out in the area between July 2016 and July 2017. Confiscation was carried out after products were identified as illegal by the Ministry of Health Enforcement and Inspection officers, upon the examination of their labels. Products were deemed illegal if they did not comply with local labelling regulations. These included lack of Hebrew text on label, missing mandatory warning labels on the possible harm due to alcohol consumption, missing and partial manufacturer data, fake rabbinic kosher labels, and erroneous claims on the nature of the product and its volume. Alcoholic beverages acquired were from the following categories: 15 products labeled as “vodka”, six labeled as “brandy flavor”, four labeled as “arak” and one labeled as “scotch flavor”. Beverages were presumed to be spirits with added caramel and liquorice for color and flavor. Sellers from whom the samples were seized did not identify the beverages as unrecorded or illegal. All samples included a claimed alcohol strength of 40% on their label. Prices of the seized 200-ml beverages ranged from 9 NIS to 21 NIS (approx. 2.05 EUR to 5.10 EUR); while the cost of a 750-ml arak bottle was 35 NIS. The price of a 1000-ml vodka bottle was not determined. These prices are commonly below the market price of local recorded alcohol of the same comparative volume.

## Chemicals and analytical methods

Samples were dissolved in a 40:60 mixture of ethanol and water, and allocated codes by a lab technician. Methanol and ethanol were analyzed using gas chromatography (GC) with a flame ionization detector (FID). Separation of compounds was performed using a Stabilwax 30 m × 0.25 mm × 0.25 μm fused silica chromatography column. The analysis employed the following parameters. Injection volume was 1 μl. Inlet temperature was 180 °C; detection temperature was 220 °C. The programmed temperature gradient was 35 °C (6 min) to 70 °C (2 min), with an increase of 8 °C/min. The detection limit reported for methanol was 0.002% volume.

## Results

The analysis of all 26 samples revealed methanol was detected in just 15 samples (57.7%). Among those 15 samples containing methanol, three were labeled as arak, five were labeled as vodka, six were labeled as brandy, and one was labeled as “scotch flavor”.

Furthermore, among those samples containing methanol, the compound’s concentration levels varied between 12 and 4534 g per hectoliter of 100% vol alcohol. Ethanol levels varied from 40% volume (v/v%), which was claimed on the labels of all the products seized. Methanol levels of 3822 and 3967 g/hl were detected in two of the samples, labeled as vodka (VP4) and brandy (PB2) respectively. In three additional samples labeled as brandy (E35), vodka (OB56) and brandy (321.0) we identified relatively high methanol levels, of 4405, 4237, and 4532 g/hl respectively. These levels are more than 400 times the European Community (2008) mandated upper methanol limit for vodka, established as 10 g methanol per hectoliter of 100% vol alcohol. The methanol and ethanol concentrations in seized samples, in comparison to EU limits for vodka, produced from ethyl alcohol of agricultural origin are presented in Table 1. Percentages of ethanol and methanol content in analyzed samples are shown in Table 2.

## Discussion

The immediate concern elicited from these results is a potential for methanol poisoning due to levels 450 times above those permitted by both European and Israeli standards for spirits. Ethanol and methanol both act as central nervous system depressants. Yet, methanol is also highly neurotoxic, can induce life-threatening metabolic acidosis, and is blindness-inducing due to formic acid accumulation during its metabolic process (Barceloux et al. 2002). A daily dose of 2 g of methanol per day for a standard person appears to be tolerable (Paine and Davan 2001). Ocular symptoms are associated with blood

concentrations above 500 mg/l, while the minimum lethal dose of methanol is considered to range between 0.3 and 1 g/kg (United Nations Environment Programme et al. 1997). Out of 26 products, 15 samples contained methanol, and five contained levels above 3000 g/hl, which would easily allow for the consumption of more than 2 g of methanol by an unsuspecting drinker. Paine and Davan (2001) defined a technological threshold under 2 v/v% methanol for a 40 v/v% ethanol-containing beverage to correlate with a tolerable exposure, when less than 100 ml of such drink are consumed over 2 h. This would amount to roughly 3950 g of methanol per 100 l of ethanol. Samples 11, 21, 23, and 24 contained levels of methanol which are above this theoretical safety margin, while sample 13 had a methanol concentration very close to this level. Nevertheless, the volume of these bottles was approximately 200 ml, which could result in the consumption of more than 8 g of methanol, well above the tolerable level and theoretical safety margin. Two of the implicated products, 11 and 13, which display labels not conforming to local alcohol labeling regulations, are shown in Fig. 1.

The South-Central area of Tel-Aviv is mainly covered by two public hospitals, the Tel Aviv Sourasky medical center in the north and the Wolfson medical center in the south. Both hospitals are located within a 4 km radius of the surveyed area, and provide secondary care for area residents. Additionally, both public hospitals provide monthly or quarterly reports to the Israel Ministry of Health Information Division, employing ICD-9 standard codes to relay patient symptoms and diagnoses. Cases involving acute methanol toxicity are likely to be referred to these hospitals. Consequently, we queried the Health Information Division for all unintended methanol poisoning reports provided by these centers for years 2015–2017.

Despite our findings confirming the sale of beverages with high methanol content in the area, only nine cases of documented unintended methanol poisoning have been reported by hospitals for the years 2015–2017 (personal communication by email to author). This fact is extremely surprising, if contrasted with epidemiological data from the United States, where methanol poisonings represented over 1700 single exposure cases in 2013, (Nikunj Kumar and Kems 2017) which are almost 1% of all poisonings reported in the United States (Ghannoum et al. 2014). Disparity between our findings, demonstrating the sale of alcoholic beverages with high methanol levels in the area, and the lack of reports on methanol poisonings by area emergency departments, suggests the possibility of under-reporting or mis-reporting. It is also possible that methanol poisonings have been reported under different ICD-9 categories than those queried. Lastly, despite sales occurring in a relatively small, limited, and disadvantaged area of Tel-Aviv, there is no evidence of increased morbidity or large methanol poisoning outbreaks in this area.

Our findings are consistent with earlier risk-analysis estimations with regard to unrecorded alcohol, in which the substance of greatest concern was determined to be ethanol rather than methanol, thus favoring policies targeted at decreasing general

**Table 1** Methanol and ethanol concentrations of seized samples in comparison to EU limits for vodka produced from ethyl alcohol of agricultural origin

Sample number	Sample	Claimed volume in label	Type of product claimed by label	Ethanol v/v%	Methanol g/hl	Times the EU limit for vodka produced from ethyl alcohol of agricultural origin <sup>a</sup>
1	F1B	200 ml	Vodka	39.6	nd	–
2	B2A	200 ml	Arak	39.9	12	1.2
3	B2B	200 ml	Arak	39.4	13	1.3
4	VR3	200 ml	Vodka	31.5	275.6	27.56
5	VA4	100 ml	Vodka	39.4	nd	–
6	IB5	1000 ml	Brandy	34.6	168.8	16.9
7	VF6	200 ml	Vodka	39.3	nd	–
8	SV7	200 ml	Vodka	39.5	nd	–
9	AK8	200 ml	Arak	38	230.6	23
10	VS7	200 ml	Vodka	44.6	217	21.7
11	PB2	200 ml	Brandy	34.2	3967	396.7
12	BG3	200 ml	Brandy	39.3	819	82
13	VP4	200 ml	Vodka	27.6	3822	382.2
14	BB5	200 ml	Brandy	38.7	23.5	2.35
15	SS6	200 ml	“Scotch flavor” (Spirit)	33.8	161	16.1
16	HV7a	200 ml	Vodka	39.4	nd	–
17	HV7b	200 ml	Vodka	41.5	nd	–
18	Hv7c	200 ml	Vodka	39.6	nd	–
19	VV8	1000 ml	Vodka	39.6	nd	–
20	EA	750 ml	Arak	38.7	nd	–
21	E35	200 ml	Brandy	33.6	4405	440
22	KRD5	100 ml	Vodka	34.2	208	20.8
23	OB56	200 ml	Vodka	32.1	4237	423.7
24	321.0	200 ml	Brandy	24.7	4534	453.4
25	ST1	200 ml	Vodka	37.2	nd	–
26	VC1	200 ml	Vodka	31.8	nd	–

nd none detected

<sup>a</sup> As indicated by European Community (2008)

alcohol consumption (Lachenmeier and Rehm 2012). Nevertheless, the existence of commercially available products with high methanol content intended for consumption should be treated as a potential public health risk. One defining characteristic of the products seized is the lack of mandated product labelling which conforms to Israeli standards and regulations. In this regard, a large number of the aforementioned sale locations are either owned or managed by foreign immigrants and asylum seekers. These have a lesser knowledge of Hebrew and of the regulations surrounding alcoholic beverage labeling. This fact may result in cases of unintended or unwitting purchase of illicit alcohol at the retailer level, attracted by the low price of the products sold by local, illegal suppliers.

**Table 2** Percentages of ethanol, methanol content in analyzed samples

	N	Minimum	Maximum	Mean ± SD
Ethanol V/V%	26	24.7	44.6	36.608 ± 4.507
Methanol g/hl	15	12	4534	1539.57 ± 1957.58

N number of samples containing compound

SD standard deviation

Current policy consists of periodic monitoring and analysis of the contents of products seized by Health Ministry and Ministry of Economy inspectors. The issuance of public warnings, informing the public on the nature of products seized and their potential harms, usually follows the identification of presumably toxic levels of methanol and alcohol denaturants in beverages. As a policy, the use of public warnings has shown some effect on drinking intentions

**Fig. 1** Samples 11 and 13 of illicit alcoholic beverages

(Anderson et al. 2009). These announcements are commonly followed with interest by local media. Consequently, authorities might benefit from translating public health warnings to Arabic and the Tigrinya language, spoken by the Sudanese and Eritrean population comprising the bulk of foreigners in the surveyed area (Population and Immigration Authority 2016). Such campaigns, particularly if targeted at shop owners and shopkeepers, could aid in diminishing the supply of illicit alcoholic drinks.

## Conclusion

We confirmed the presence of methanol in suspected illicit alcoholic drinks sold in the low socio-economic level area around Tel-Aviv's central bus station area and the Hatikvah neighborhood. Although there is a potential for severe methanol intoxication due to the ingestion of these drinks, current data and reports do not indicate there is a related, existing health problem in the area. Nevertheless, limited data on methanol poisoning cases in emergency departments in Tel-Aviv hospitals could well indicate that cases are under-reported, or mis-reported, by hospital authorities. The sale of illicit alcoholic drinks at low market prices could negatively affect the health of disadvantaged populations in the immediate area such as drug addicts, alcoholics, adolescents, and migrants with diminished access to healthcare. Authorities should be aware of the need to reduce risk by monitoring the sale of unrecorded and illicit alcohol and making relevant health and regulatory information accessible to foreign, non-Hebrew speakers in the area. A larger sample is still needed to appreciate the extent of illicit and harmful alcohol sale in the area.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed consent** Not applicable.

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