Jiang et al., J Food Nutr Disor 2016, 5:4
DOI: 10.4172/2324-9323.1000200

Journal of Food & Nutritional Disorders

Research Article

A SCITECHNOL JOURNAL

Exposure Assessment to Methanol from Alcoholic Beverage of Residents (≥ 15 Years Old) in Guangdong Province

Jiang Q[1], Tan YF[2], Chen Zh[1], Dun ZJ[1], Wang P[1], Huang R[1], Ji GY[1] and Zhang YH[2*]

Abstract

Data from GNHS 2009-2012 was used to investigate the alcoholic beverage consumption situation of Guangdong province. A total of 1532 alcoholic beverages were randomly sampled in the spots where GNHS were conducted. Methanol content was detected by gas chromatograph. There was 13 samples among 1589 containing methanol exceeded the limits, with the highest average level of methanol in tequila (1.45 g/L). The hazard indices of alcoholic beverages calculated by methanol RfD 2 mg/kg bw day (US EPA). As with the hazard index, exposures below a HI of 1.0 will likely not result in adverse health effects over a lifetime of exposure. Then the methanol exposure via the alcoholic beverages might not do hazard to Guangdong provincial residents.

Keywords

Methanol; Alcoholic beverages; Risk assessment; South China

Introduction

Methanol, also known as wood alcohol, is the smallest member of aliphatic alcohol. Methanol occurs naturally in humans, animals and plants. Methanol is readily absorbed by inhalation, ingestion and dermal exposure. Ingestion dominates as the most frequent route of poisoning. Humans (and non-human primates) are uniquely sensitive to methanol poisoning and the toxic effects in these species is characterized by formic academia, metabolic acidosis, ocular toxicity, nervous system depression, blindness, coma and death [1]. In March 2012, US Office of Environmental Health Hazard Assessment (OEHHA) formally determined methanol as chemical pollutant of developmental toxicity. United States Environmental Protection Agency (EPA) set 2 mg/kg bw/day) as Reference Dose (RfD) of methanol in 2013 [2].

It was reported that methanol occurs naturally at a low level in most alcoholic beverages with harm not calculated [3]. Guangdong Province is the most densely populated province in South China [4]. Since reforms and opening up to the outside world, the economics of Guangdong province have been booming, and it has a huge consumption of alcoholic beverages, but there was no systematic data available on methanol levels in alcoholic beverages from Guangdong province markets and exposure risk assessment to methanol. The alcohol market in Guangdong province ranges from international commercial alcohol including brandy, tequila, wine, to locally produced alcohol such as spirits, beer, rice wines. This study investigates methanol in alcoholic beverages from Guangdong markets and the possible risk to public health with special regards to the heavy consumers.

Subjects and Methods

Analysis of the consumption of alcoholic beverages in Guangdong province

The Guangdong Nutrition and Health Survey (GNHS) 2009-2012 were conducted by the Guangdong Province Center for Disease Control and Prevention and the Health Bureau of Guangdong Province in 2009-2012. GNHS was a continuous program that focused on a variety of health and nutrition measurements. The sampling methods and survey protocols as well as the quality control for the GNHS 2009-2012 were similar to those for the CNNHS 2002 and GNHS 2002 [5,6]. The stratified multistage cluster sampling with probability proportion to size method was used in the survey, and the sampling details had been described elsewhere. Three different stages of investigated areas including large cities, medium cities and rural areas were classified for the survey. According to their characteristics of economy and social development using data from the China National Bureau of Statistics and China Ministry of Health Statistics, cities were divided mainly by population size and gross national product, and rural areas were classified mainly according to the gross national product.

A total of 13,979 residents from 5,463 households were included in the GNHS 2009-2012, representing the Guangdong provincial permanent residential population of 104,320,459 in 2010. Ethics approval was obtained from the ethics committee of China Center for Disease Control. All participants gave informed consent before the survey.

A central survey site was set up in each residential committee or village and the participants were required to be interviewed and receive the health examination on-site. All interviews and examinations were conducted following standardized protocols by physicians who received training specifically for the GNHS 2009-2012. The questionnaire interview collected a wide range of information including demographic characteristics, socio-demographic factors, family, and personal disease histories.

Alcohol drinker was defined as currently or having drink at least once over the last 12 months. Chinese Nutrition Society published amended guidelines for safe drinking, recommending that men should not exceed 25 g of alcohol per day and that women limit their consumption to 15 g per day, in 2010. Those who consumed more than the limits were heavy drinkers. Drinking rate is the percentile of alcohol drinker in the investigated population.

Calculation of alcohol consumption: transfer the alcohol volume of the alcohol beverages into alcoholic strength by asking for the average alcohol consumption in the past 12 months. It was defaulted that in this article, 52% volume for heavy white wine, 38% volume for light white wine, 4.3% volume for beer, 18% volume for yellow wine,

***Corresponding author:** Yonghui Z, Guangdong Provincial Center for Disease Control and Prevention, Guangzhou, China, Tel: 86 20 31051688; Fax: 86 20 31051652; E-mail: zyh@cdcp.org.cn

Received: April 26, 2016 **Accepted:** June 14, 2016 **Published:** June 23, 2016

10% volume for red wine, 10 g alcohol equals to 25 g heavy white wine, or 35 g light white wine, or 0.5 bottle of beer or 1 can of beer or 75 g yellow wine or 150 g"[7].

Data analysis was conducted by soft SAS 9.3. According to gender, age, area, and data on consumption of alcoholic beverages in Guangdong province for the population older than 15 were analyzed. All analyses accounted for the complex sampling design effect and appropriate sampling weights of the national survey using PROC SURVEY in SAS program. Variables were expressed as mean ± standard error of mean for continuous variables or percentages for categorical variables. According to Guangdong 2010 population census data, the drinking rates were standardized. Means and P97.5 were both used to describe the consumption of all kinds of alcoholic beverages.

Determination of methanol content of alcoholic beverages

According to the consumption of alcoholic beverages by GNHS 2009-2012, the sampling list of alcoholic beverages was determined. Convenient random sampling of alcoholic beverages was conducted in markets in Shenzhen, Guangzhou, Zhuhai, Zhaoqing, Foshan, Huizhou, Yangjiang, and Shaoguan where GNHS 2009-2012 happened.

Referring to 'GB/T 5009.48-2003 Method for analysis of hygienic standard of distilled wines and mixed wines", methanol content were detected by gas chromatography. Shimadzu GC-2010 gas chromatograph (GC), with a flame-ionization detector (FID), equipped with automatic sampler and chem station was used. The standard solution of methanol was 1.00 mg/mL in ethanol aqueous solution (Purchased from China Institute of Metrology).

The basic chromatographic conditions were: column ZB-WAX plus, 30.0 m × 0.32 mm × 0.50 μm, temperature of vaporization chamber was set at 250°C, flow rate of carrier gas was constantly 3.0 mL/min, and split ratio was set at 10:1. Column temperature program: 50°C hold for 5 min, 250°C/min to 230°C hold for 6 min; temperature of detector was set at 250°C, hydrogen at a constant flow rate of 40 mL/min, air at 400 mL/min. The samples were injected directly into the sample bottle after shaking. Automatic sampling by volume of 1. The recovery was 96%-99%. All samples were analyzed in triplicate, and average values were reported.

Data interpretation and statistics

Analytical results might be reported as non-detectable (i.e. below the limit of detection (LOD)). In such cases, the true value could be anywhere between zero and LOD. The treatment for these results was particularly important when a large proportion of the analytical results were below LOD The recommendation of the World Health Organization (WHO) on evaluation of low-level contamination of food in treatment for those non-detected results were adopted. According to the recommendation, half of LOD was used for all results less than LOD when less than or equal to 60% of results were below LOD, while two estimates using zero and LOD for all results less than LOD were produced when more than 60% of results were below LOD[8]. Soft SPSS13.0 was used for the methanol content analysis. Means ± standard deviations, and median were described for methanol content in wines.

According to GB 2757-2012 "National Food Safety Standard Distilled wines and mixed wines", the methanol limit in white wines was 0.6 g/L (by 100% volume alcohol), with 2.0 g/L as the limits of other distilled wines (by 100% volume alcohol). However, methanol content more than 0.6 g/L in mixed distilled wines (by 100% volume alcohol) was out of limits. In addition, methanol limits of tequila were 3.0 g/L (by 100% volume alcohol). No limits for methanol were listed in GB 2758-2012" National Food Safety Standard Fermented wines and mixed wines".

Exposure assessment

Deterministic assessment was conducted to assess the dietary exposure to methanol. Mean (P97.5) exposure=Mean content of methanol in alcoholic beverages × daily mean (P97.5) wine consumption [9].The mean and 97.5th percentile of the exposure levels are used to represent the average dietary exposure and the exposure for heavy drinkers. Hazard index (HI) were used to calculate the risk of methanol based on the RfD (2 mg/kg bw/day) according to EPA in 2013 [10].

Results

Alcoholic beverage consumption in Guangdong Province

Totally, 8972 residents aged more than 15 were investigated in Guangdong province, with 3797 male and 5175 female. The effective investigated proportion was 92.8% (8972/9672). The drinking rate of residents in Guangdong Province was 33.3%. The average daily alcohol intake was 3.1 g (Table 1). The most popular consumed type of alcoholic beverages was beer (1599 people had ever drink), followed by wine (1173 people had ever drink). The average daily alcohol intake of drinkers was 9.6 g (Table 2). The ratio of heavy drinkers in alcohol consumption population was 11.3%; the average daily intake of heavy drinkers was 74.6 g.

The main alcoholic beverages consumed in Guangdong were Chinese spirits, followed by beer and red wine, as shown in Table 3. The number of male drinkers was much more than that of female drinkers. The daily alcohol intake from low spirits of general population, P97.5 population were 1.16 g, 1.68 g, daily alcohol intake from high spirits was 0.85 g, 1.48 g, daily alcohol intake from rice wine was 0.04 g, 0.07 g, daily alcohol intake from beer was 0.86 g, 1.62 g, daily alcohol intake from wine was 0.14 g, 0.18 g.

However, the mean and P97.5 daily intake of alcohol of drinkers from low spirits were 9.43 g and 13.25 g, from high spirits were 12.77 g and 23.10 g, from rice wine were 1.09 g and 1.63 g, from beer were 3.92 g and 6.95 g, from wine were 0.90 g and 1.06 g, from other alcohol were 5.22 g and 7.46 g (Table 4).

Methanol content of alcoholic beverages

A total of 1589 samples were collected, including 1143 distilled wines, 258 mixed wines, 188 fermented wines. The methanol content of 3 samples of high spirits, 1 of brandy, 9 of plant mixed wine exceeded the Chinese limits. The highest mean content of methanol in alcoholic beverages was 1.45 g/L in tequila (0.92 ~ 2.40 g/L), followed by high spirits, which is 0.405 g/L. The highest methanol content of mixed wines is made of plant, which is 0.20 g/L. The average content of methanol in red wines was 173.4 mg/L. The average content of methanol in beer and rice wine were both under the LOD (Table 5).

Table 1: Alcoholic consumption status of residents (≥ 15 years old) in Guangdong province.

group	Number of sample	Proportion (%)	Drinking number	Raw drinking rate (%)	Standard drinking rate (%)	Alcohol intake (g/d)	Number of over drinkers	Percentage of over drinkers among drinker (%)
Gender								
Male	3797	42.3	1787	47.1	46.6	5.6 ± 1.3	281	15.7
Female	5175	57.7	971	18.8	19.3	0.3 ± 0.0	30	3.1
Area								
Large cities	2886	32.2	1077	37.3	37.6	4.8 ± 2.2	100	9.3
Medium cities	3411	38.0	1120	32.8	34.6	3.0 ± 0.9	141	12.6
Rural areas	2675	29.8	559	20.9	26.8	2.4 ± 0.5	70	12.5
Age								
15~17	429	4.8	62	14.5	13.4	0.1 ± 0.0	0	0.0
18~29	1454	16.2	468	32.2	34.4	1.8 ± 0.3	17	3.6
30~44	2743	30.6	1057	38.5	42.4	3.5 ± 1.4	107	10.1
45~59	2522	28.1	782	31.0	35.9	5.7 ± 1.8	125	16.0
≥ 60	1824	20.3	389	21.3	22.4	3.7 ± 1.0	62	15.9
Total	8972	100.0	2758	30.7	33.3	3.1 ± 0.7	311	11.3

Table 2: Intake of alcohol for different area and gender in Guangdong province (`χ ± g/d).

Pattern of drinkers	Area	Male	Female	Total
Drinkers	Large cities	20.7 ± 9.3	2.0 ± 0.6	15.0 ± 6.7
	Medium cities	11.5 ± 3.2	1.8 ± 0.2	8.8 ± 2.4
	Rural areas	12.2 ± 0.9	1.3 ± 0.2	9.4 ± 0.9
	total	12.6 ± 2.7	1.8 ± 0.2	9.6± 2.1
Heavy-drinkers	Large cities	140.7 ± 94.6	26.3 ± 7.7	130.0 ± 85.8
	Medium cities	71.4 ± 9.6	33.8 ± 5.4	68.3 ± 9.5
	Rural areas	67.1 ± 4.5	22.7 ± 0.5	64.7 ± 3.7
	total	78.4 ±12.0	31.1 ± 3.3	74.6 ± 11.5

Table 3: The drinking type of residents (≥ 15 years old) in Guangdong province.

group		Number of drinkers	Number of different alcoholic beverage drinkers				
			Low sprits	High spirits	Rice wine	Beer	Red wine
Gender	Male	1787	832 (46.6)	521 (29.2)	215 (12.0)	1178 (65.9)	652 (36.5)
	Female	971	270 (27.8)	75 (7.7)	209 (21.5)	421 (43.4)	521 (53.7)
Area	Large cities	1077	378 (35.1)	262 (24.3)	170 (15.8)	693 (64.3)	549 (51.0)
	Medium cities	1120	495 (44.2)	219 (19.6)	125 (11.2)	637 (56.9)	518 (46.3)
	Rural areas	559	229 (41.0)	115 (20.6)	129 (23.1)	269 (48.1)	106 (19.0)
Age	15~17	62	8 (12.9)	1 (1.6)	2 (3.2)	55 (88.7)	22 (35.5)
	18~29	468	99 (21.2)	64 (13.7)	46 (9.8)	375 (80.1)	220 (47.0)
	30~44	1057	386 (36.5)	273 (25.8)	184 (17.4)	722 (68.3)	498 (47.1)
	45~59	782	398 (50.9)	186 (23.8)	142 (18.2)	342 (43.7)	297 (38.0)
	≥ 60	389	211 (54.2)	72 (18.5)	50 (12.9)	105 (27.0)	136 (35.0)
	Total	2758	1102 (40.0)	596 (21.6)	424 (15.4)	1599 (58.0)	1173 (42.5)

Note: The figures in the brackets mean the percentages of different alcoholic beverages among the whole drinkers (%)

Risk assessment of methanol exposure from alcoholic beverages

The methanol HI of different alcoholic beverages drinkers were all below 1. The average methanol HI of drinkers were ranged between 0.005 ~ 0.079. The P97.5 HI to methanol of drinkers were 0.007 ~ 0.113. The exposure risk of tequila drinkers were the highest, followed by brandy. No matter age, area, gender were concerned, the HI were all low than 1. HI of all alcoholic beverages of 45 ~ 59 years' old males in large cities were higher than other populations (Table 6).

Discussion

Drinking behavior of Guangdong residents

As more as 33.3% of residents aged 15 and more in Guangdong province have drink once or more, which was a little higher than

Table 4: Alcoholic intake from different spirits for residents(≥ 15 years old) in Guangdong province (g/day).

group	Average residents									drinkers									
	Low sprits		High spirits		Rice wine		Beer		Red wine	Low sprits		High spirits		Rice wine		Beer		Red wine	
	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$
Gender																			
Male	2.16	3.11	1.62	2.84	0.05	0.08	1.61	3.05	0.22	0.29	10.85	15.09	13.98	25.29	1.25	1.74	4.72	8.48	1.18	1.37
Female	0.11	0.14	0.04	0.06	0.03	0.06	0.07	0.12	0.05	0.06	2.62	4.5	2.61	3.95	0.89	1.61	0.81	1.34	0.41	0.56
Area																				
Large cities	1.33	2.8	2.89	6.15	0.07	0.13	1	1.87	0.2	0.36	10.24	23.13	29.5	74.48	1.42	1.84	3.89	6.87	1.08	1.69
Medium cities	1.18	1.9	0.62	1.12	0.04	0.08	0.95	2.1	0.16	0.19	8.81	12.93	9.07	16.74	1.21	2.15	4.11	8.28	0.91	1.1
Rural areas	1.02	1.09	0.66	1.14	0.04	0.09	0.47	0.91	0.03	0.06	12.19	12.3	14.67	17.68	0.73	0.81	2.99	4.1	0.57	0.62
Age																				
15 ~ 17	0	0.01	0	0	0	0	0.05	0.09	0.04	0.09	0.18	0.24	0.03	0.03	0.35	0.84	0.4	0.63	0.68	1.39
18 ~ 29	0.41	0.6	0.17	0.25	0.01	0.02	1.03	1.52	0.23	0.32	5.16	6.59	3.65	5.58	0.51	0.82	3.6	5.62	1.43	1.58
30 ~ 44	0.95	1.71	0.82	1.73	0.07	0.13	1.48	3.28	0.13	0.17	6.17	10.67	8.1	15.82	1.2	2.02	4.9	10.71	0.63	0.91
45~59	2.29	4.01	2.3	4.74	0.06	0.1	0.59	1.07	0.13	0.19	11.81	22.29	25.26	58.68	1.14	1.74	3.76	6.62	0.89	1.23
≥ 60	2.65	4.73	0.88	1.35	0.04	0.08	0.05	0.09	0.08	0.12	22.44	33.68	23.9	31.68	1.45	2.16	0.96	1.65	0.93	1.41
Total	1.16	1.68	0.85	1.48	0.04	0.07	0.86	1.62	0.14	0.18	9.43	13.25	12.77	23.10	1.09	1.63	3.92	6.95	0.90	1.06

Table 5: Methanol content of alcoholic beverages (g/L, by 100% vol alcohol).

Sorts of wines		N	X	SD	Medium	Ranges of detected	$P_{97.5}$	limits
Distilled wines	Low spirits	257	0.05	0.03	0.04	0.00 ~ 10.30	0.13	0.6
	High spirits	454	0.07	0.08	0.04	<0.03 ~ 0.71	0.32	0.6
	brandy	280	0.38	0.23	0.32	0.03 ~ 2.20	1.29	2.0
	Whisky	124	0.08	0.07	0.06	<0.03 ~ 0.42	0.26	2.0
	Vodka	10	<0.03	--	<0.03	< 0.03	<0.03	2.0
	Rum	9	<0.03	--	<0.03	<0.03 ~ 0.07	0.07	2.0
	Tequila	9	1.45	0.51	1.24	0.92 ~ 2.40	2.40	3.0
Mixed wines	Plant mixed wine	164	0.17	0.24	0.07	<0.03 ~ 1.54	1.03	0.6
	Animal mixed wines	54	0.08	0.07	0.06	<0.03 ~ 0.4	0.36	0.6
	Animals and plants mixed wine	40	0.11	0.08	0.07	<0.03 ~ 0.32	0.32	0.6
Fermented wines	Red wine*	128	173.40	49.95	174.00	44.00 ~ 298.00	278.07	-
	beer	30	--	--	--	--	--	--
	Rice wine	30	--	--	--	--	--	--

Notes: *Units of methanol content of red wine is mg/L; Limits of detection (LOD) was 0.03 g/L (by 100% vol alcohol)

Table 6: Hazard index calculation based on the methanol intake amount via kinds of alcoholic beverages of residents (≥ 15 years old) for Guangdong province.

Variable	Low spirits		High spirits		Red wine		Brandy		Tequila	
	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$	X	$P_{97.5}$
Gender										
Male	0.006	0.008	0.010	0.019	0.018	0.021	0.025	0.039	0.094	0.147
Female	0.002	0.003	0.002	0.003	0.006	0.009	0.011	0.018	0.041	0.067
Area										
Large cities	0.005	0.012	0.022	0.055	0.016	0.026	0.018	0.022	0.069	0.084
Medium cities	0.005	0.007	0.007	0.012	0.014	0.017	0.018	0.034	0.067	0.128
Rural areas	0.006	0.007	0.011	0.013	0.009	0.010	0.026	0.039	0.100	0.149
Age (years old)										
15 ~ 17	0.000	0.000	0.000	0.000	0.010	0.021	0.001	0.001	0.002	0.002
18 ~ 29	0.003	0.004	0.003	0.004	0.022	0.024	0.010	0.018	0.036	0.068
30 ~ 44	0.003	0.006	0.006	0.012	0.010	0.014	0.011	0.016	0.041	0.062
45 ~ 59	0.006	0.012	0.019	0.043	0.014	0.019	0.040	0.074	0.151	0.283
≥ 60	0.012	0.017	0.018	0.023	0.014	0.021	0.024	0.035	0.092	0.134
Total	0.005	0.007	0.010	0.017	0.014	0.016	0.021	0.030	0.079	0.113

national level in 2010 [11]. Although the definition of alcoholic drinking and investigated population was different, the conclusion that male's drinking rate was higher than female's, people in larger cities drink more than those in medium cities and rural areas, were the same. It was not popular for female to drink alcoholic beverages in Chinese traditional culture, which is a protection for female, avoiding alcohol related damage. Male, especially young and adult ones, are more socially active, who were prone to drink more frequently. After the age of 60, drinking rate fell down sharply with social activities.

Drinking type and alcoholic intake

It was shown the main drinking type of residents (≥ 15 years old) were sprits, beer and wines. Spirits were the favorite for male, while wine is the favorite for female, which was concurrent with the national investigation from 1993-2006 [12]. It meant the like of different genders were different, male for higher alcoholic strength, and female for lighter alcoholic strength [13]. However, higher alcoholic strength means higher alcoholic intake which means higher health risk.

Alcoholic intake from consumption of high spirits was 12.77 g/day, which is ten times of that from wines (0.90 g/day). The average alcoholic intake from high spirits for male was 13.98 g/day, P97.5 alcoholic intake was 25.29 g/day. Comparing with Chinese resident dietary guideline (daily alcoholic intake for adult male should be no more than 25 g), the daily alcoholic consumption from high spirits for some male, had already exceeded the recommended alcohol intake limits, which may cause some health risk. It is necessary to do some warn for male over-drinkers. At the same time, it is appropriate to actively carry out the limit of wine, moderate drinking education work.

Methanol content of alcoholic beverages

The presence of methanol in distilled wines is related to the pectin content, pectin being broken down during production leading to the release of methanol. Some illegally distilled or counterfeit alcoholic drinks have been found to contain much higher concentrations of methanol with drinks made from "industrial methylated spirits" containing methanol [14]. In our research, the methanol exceeding rate was 0.82% (13/1589), which indicated most of distilled wines in Guangdong markets were accordant with national standards. The highest methanol content of distilled wines is of tequila, with the detected results of 1.45 g/L ± 0.51 g/L. It was reported that methanol content of tequila is between 0.2 and 4.0 g/L [15]. Our results were in agreement with the literature. Tequila is the most known agave derived mezcal (Agave tequilana Weber var. azul, Agavaceae), generally between 37%-40% vol. Tequila is rich in pectin and can produce a certain amount of methanol in the fermentation process. As a result, the methanol content of tequila may be higher. However, the results of methanol content of tequila were all lower than the required limits. The methanol content of 3 high spirits were exceeded the standard limits, which were, respectively, 100 and 146 times higher than the limits. Once 2.7 g high spirit with methanol content 146 higher than the limits was consumed; the methanol intake would be 2.7 g, which would exceed the RfD set by US EPA. The situation would be risky.

Methanol content of nine samples out of 164 plant mixed wines was higher than the limit (range of methanol contents were between 0.65 and 6.00 g/L. Mixed wines are special Chinese traditional drinking, made of distilled wines pickled with plants/animals (e.g. ginseng or snakes). The methanol exceeding rate is the highest, which might be related to the raw material of plants.

Risk characteristics of methanol in alcoholic beverages

Methanol HI of low spirits, high spirits, brandy, whisky, vodka, rum, tequila were all much lower than 1, which means the residents (age ≥ 15) of Guangdong province might be safe from methanol exposure of alcoholic beverages. Under current consumption and methanol content, no adverse effects would be considered. However, methanol exposure risk of tequila and brandy consumption population was higher than other spirits consumption population. It is necessary to do specific investigation and risk assessment for tequila consumption.

Besides, the main composition of alcoholic wine is alcohol. Although it is found that regular light drinking is preventive for heartache, the consumption of alcohol is harmful for health. Alcohol is a psychoactive substance with dependence-producing properties. The harmful use of alcohol ranks among the top five risk factors for disease, disability and death throughout the world [16]. It is a causal factor in more than 200 disease and injury conditions. Drinking alcohol is associated with a risk of developing such health problems as metabolic syndrome, liver cirrhosis, cancers and injuries [17]. The net effect of harmful use of alcohol is approximately 3.3 million deaths each year, even when the beneficial impact of low risk patterns of alcohol use on some diseases is taken into account. Thus, harmful use of alcohol accounts for 5.9% of all deaths worldwide [18]. Recommendation of Chinese resident dietary guideline is: the daily consumption of alcohol should be limited no more than 25g for male, 15 g for female. Pregnant women and children should be forbidden drinking. Comparing with this guideline, the percentile of population that consumed more than the recommended intake limit of alcohol is 11.3%. The daily alcohol intake was lower than the recommended limit for both genders, with 50.4% of the recommended limit for male, 12% for female. However, the daily alcoholic intake of over drinkers is 314% of the recommended limit for male, 207% for female, which means alcohol poses a certain health risk for this population. It is apparent that the health risk from alcohol of alcoholic beverages is much bigger than methanol. At the same time, it was reported that the most important determinants of susceptibility to methanol toxicity are concurrent ingestion of alcohol, which reduces susceptibility [1].

Current national standards of methanol in alcoholic beverages

If the methanol content of distilled wines come up to the limits of GB 2757-2010, methanol average exposure range is 0.011 ~ 0.368 mg/kg bw, with HI between 0.006 ~ 0.184. The P97.5 high exposure is 0.019 ~ 0.499 mg/kg bw, with HI between 0.001 ~ 0.250, which did not means health hazard from methanol.

If the methanol content of distilled mixed wines came up to the limits (≤ 2.0 g/L, by 100% vol. alcohol), the average exposure level was 0.006 ~ 0.218 mg/kg bw, with HI between 0.003 ~ 0.011, according to the current alcoholic consumption. The exposure range of P97.5 high consumers was 0.011 ~ 0.311 mg/kg bw, with HI between 0.006 ~ 0.0156, which also brings no health hazard of methanol for drinkers.

For tequila, no relative Chinese food safety standards could be referred to and 3.0 g/L were recommended as methanol limit of tequila [19]. Supposing the methanol content of tequila is high up to the limit, the average exposure ranges were 0.009 ~ 0.326 mg/kg bw, with 0.005 ~ 0.016. The P97.5 high exposure ranged 0.017 ~ 0.466 mg/kg bw, with 0.009 ~ 0.233. However, tequila is not traditional and popular in China, the exposure level is overestimated. The exposure risk of methanol of tequila was safe for both average residents and high consumers, under current consumption level and relative limits.

One limitation of this assessment include the food survey was conducted using a questionnaire of food frequency (FFQ). The FFQ is able to know how often and how much all kinds of alcoholic beverages were consumed, but the daily methanol exposure accumulation from all the alcoholic beverages could not be calculated.

Conclusion

Methanol exposure from alcoholic beverages means no harm to residents aged more than 15 years old in Guangdong province in South China. The current methanol limits of national standards are reasonable protective measure under current alcoholic consumption level. There is no need to amend the standards. The harm of drinking is over-consumption of alcohol from binge drinking, not the exposure of methanol.

References

1. WHO (1997) Environmental Health Criteria196. Methanol Geneva.
2. US EPA (2013) Toxicological review of methanol (Noncancer) (Revised External Review Draft). Environmental Protection Agency Washington.
3. Lachenmeier DW, Rehm J, Gmel G (2007) Surrogate alcohol: What do we know and where do we go? Alcohol Clin Exp Res 31: 1613-1624.
4. Yu-fei T, Qi J, Zhong-Jun D (2015) Status and associated factors of alcohol consumption among residents aged 15 and above in Guangdong Province. China J Prev Med 41: 213-217.
5. Wu Y, Huxley R, Li L, Anna V, Xie G, et al. (2008) Prevalence, awareness, treatment and control of hypertension in China: data from the China National Nutrition and Health Survey 2002. Circulation 118: 2679-2686.
6. Ma WJ, Tang JL, Zhang YH, Xu YJ, Lin JY, et al. (2012) Hypertension prevalence, awareness, treatment, control and associated factors in adults in southern China. Am J Hypertens 25: 590-596.
7. Guangdong provincial Center of Disease Control and Prevention (2013) Adult chronic diseases and related risk factors of adolescent health risk behavior monitoring report of Guangdong province, Guangzhou.
8. WHO (1995) GEMS/Food-EURO second workshop on reliable evaluation of low-level contamination of food. Report of a Workshop in the Frame of GEMS/Food-EURO.
9. International Programme on Chemical Safety, Principles and methods for the risk assessment of chemicals in food (2009) 41-60.
10. Chang-Hwan Oh, Ye-Ji Lee, Sung Hee Min (2013) Estimation of methanol exposure level via alcoholic beverage consumed by Jecheon Citizen, South Korea. Food and Nutrition 26.
11. China CDC (2010) Report on chronic disease risk factor surveillance in China 2012 Military Medical Science Press, Beijing.
12. Ma Yuxia, Zhang Bing, Wang Huijun, Du Wenwen, Su Chang, et al. (2011) Status and trend of alcohol consumption among adults in nine provinces of China from 1993 to 2006. Chin J Prev Med 45: 323-329.
13. Qiu-Mao C, Yan-Jun X, Xiao-Jun X, Zheng-Lu H, Zhi-Yao Z (2014) Investigation on drinking behaviors among residents aged over 18 years in Guangdong Province. Modern Preventive Medicine 41: 1818-1821.
14. Paine A, Davan AD (2001) Defining a tolerable concentration of methanol in alcoholic drinks. Hum Exp Toxicol 20: 563-568.
15. Lachenmeier DW, Sohnius EM, Attig R, Lopez MG (2006) Quantification of selected volatile constituents and anions in Mexican Agave spirits (Tequila, Mezcal, Sotol, Bacanora). J Agric Food Chem 54: 3911-3915.
16. WHO (2011) The global status report on alcohol and health 2011 Geneva.
17. Wakabayashi I (2010) Cross-sectional relationship between alcohol consumption and prevalence of metabolic syndrome in Japanese men and women. J Atheroscler Thromb 17: 695-704.
18. WHO (2014) Global status report on alcohol and health 2014.
19. National Health and Family Planning Commission of the People's Republic of China (2013) An Explanation of Tequila of National Health and Family Planning Commission of China.

Author Affiliation

Top

[1]*Guangdong Provincial Institute of Public Health, Guangdong Provincial Center for Disease Control and Prevention, Guangzhou, China*

[2]*Guangdong Provincial Center for Disease Control and Prevention, Guangzhou, China*