

## Alcoholic Beverage Consumption\*

Known to be a human carcinogen

First Listed in the *Ninth Report on Carcinogens* (2000)

### Carcinogenicity

Consumption of alcoholic beverages is *known to be a human carcinogen* based on sufficient evidence of carcinogenicity in human studies that indicate a causal relationship between consumption of alcoholic beverages and cancer. Studies indicate that the risk of cancer is most pronounced among smokers and at the highest levels of consumption. Consumption of alcoholic beverages is causally related to cancers of the mouth, pharynx, larynx, and esophagus. Cohort and case control studies in a variety of human populations are notable for their consistency in reporting the presence of moderate to strong associations with dose-response relationships for these four sites. Evidence supports a weaker, but possibly causal, relation between alcoholic beverage consumption and increased risk of cancers of the liver and breast (Longnecker 1994). The effect of a given level of alcoholic beverage intake on absolute risks of cancer of the mouth, pharynx, larynx, and esophagus is influenced by other factors, especially smoking. However, smoking does not explain the observed increased risk of cancers associated with increased alcoholic beverage consumption (IARC 1988, Longnecker and Enger 1996).

No adequate experimental animal carcinogenicity studies of alcoholic beverages have been reported in the literature. Studies specifically examining the carcinogenicity of ethanol in animals have not yielded results that would suggest that the ethanol component of alcoholic beverages is solely responsible for the increases in cancer observed in people consuming alcoholic beverages.

### Additional Information Relevant to Carcinogenicity

Increased frequencies of chromosomal aberrations, sister chromatid exchanges, and aneuploidies have been found in the peripheral lymphocytes of alcoholics. Ethanol-free extracts of some alcoholic beverages induced sister chromatid exchanges in human cells *in vitro* and mutations in bacteria (IARC 1988).

The mechanism by which consumption of alcoholic beverages can cause cancers in humans is not established.

### Properties

Ethanol and water are the main constituents of most alcoholic beverages. Using a standard measure of most drinks, the amount of ethanol consumed is similar for beer, wine, and spirits (10 to 14 g). Beer, wine, and spirits also contain volatile and nonvolatile flavor compounds that originate from raw materials, fermentation, wooden casks used for maturation, and synthetic substances added to specially flavored beverages. The exact composition of many beverages is confidential business information, though many published data define the organic compounds typically present at low levels. Several of the components and contaminants identified in beer, wine, and spirits are known or suspected human carcinogens, including acetaldehyde, nitrosamines, aflatoxins, ethyl carbamate (urethane), asbestos, and arsenic compounds (IARC 1988).

### Use

Alcoholic beverages have been made and used by most societies for thousands of years (IARC 1988). Consumption trends, including overall level of alcohol consumption, beverage choice, age and sex differences, and temporal variations, differ among and within societies. In many cultures, alcohol also has been used in medicine and various pharmaceutical preparations.

### Production

All alcoholic beverages are produced by the fermentation of fruit or other vegetable matter. Most commercial and home production involves fermented beverages that are classified, based on raw materials and production methods used, as beer, wine, or spirits, although smaller quantities of other kinds of fermented beverages (cider, rice wine, palm wine, etc.) also are produced. Beer is produced by fermentation of malted barley or other cereals with the addition of hops. Wine is made from fermented grape juice or crushed grapes; fortified wines include additional distilled spirits. Distilled spirits, so named because of liquid distillation to increase the alcohol content after sugar fermentation, originate from sources of starch or sugar, including cereals, molasses from sugar beets, grapes, potatoes, cherries, plums, and other fruits (IARC 1988). Although ethanol can be chemically synthesized from ethylene, alcohol synthesis for use in beverages is not employed by the alcoholic beverage industry because of the presence of impurities from the synthetic process.

In 1990, American wine production was 4.5 million metric tons (10 billion pounds), beer production was 375 million hectoliters (10 billion gallons), and spirit production was 18.5 million hectoliters (490 million gallons) (ARF 1994). World total production of the same beverages was 29 million metric tons (6.4 billion pounds) of beer, 1 million hectoliters (26.4 million gallons) of wine, and 58 million hectoliters (1.5 billion gallons) of spirits. In the United States in 2001, per capita consumption of beer was 21.7 gallons (82.1 L), of wine was 2.0 gallons (7.6 L), and of distilled spirits was 1.3 gallons (4.9 L) (USDA 2003). The United States International Trade Administration (ITA) tracks import and export data for various categories of beer, wine, distilled spirits, and other alcoholic beverages. In 2002, U.S. domestic exports and imports of many alcoholic beverages ranged from millions to billions of liters (ITA 2003).

### Exposure

A downward trend in alcohol consumption occurred in the United States and many European countries from the turn of the twentieth century until the period between the world wars. Alcohol consumption in the United States increased from the 1940s until the early 1980s, and then began to decrease steadily. By 1993, consumption had declined to the lowest level since 1964. Apparent per capita consumption expressed in gallons of pure alcohol per year was 1.6 gallons in 1940, approximately 2.2 gallons in 1964 and 1993, and approximately 2.8 gallons in 1980. Per capita consumption of wine and beer in the United States was relatively stable over the period beginning in the early 1980s and continuing into the 1990s when overall alcohol consumption was falling (Williams *et al.* 1995). Most of the decrease in alcohol consumption can be attributed to decreased consumption of spirits. Per capita consumption of wine was the same in 1993 as it was in 1977, while consumption of spirits fell by almost 35% over the same period. Per capita consumption of beer decreased from 1981 to 1985, fluctuated thereafter, and in 1993 was 1% below 1977 consumption levels (NIAAA 1997). The total number of drinks consumed in the United States in 1999 was about 65.5 billion for beer, 13.7 billion for wine, and 29.3 billion for distilled spirits. Underage drinkers (aged 12 to 20) consumed 19.7% of the total, and adult excessive drinkers (more than 2 drinks per day) accounted for 46.3%. The heaviest adult drinkers (highest 2.5%) consumed 27% of the total (Foster *et al.* 2003).

Since 1971, the Substance Abuse and Mental Health Administration (SAMHSA 2003) has conducted an annual survey on the use of illicit drugs, alcohol, and tobacco by the civilian, noninstitutionalized population of the United States aged 12 years old or older. This survey, now called the National Survey on Drug Use and Health (formerly called the National Survey on Drug Abuse) reports prevalence and trends of alcohol consumption at three levels. These include current use (at least one drink in the past 30 days), binge use (five or more drinks on the same occasion at least once in the past 30 days), and heavy use (five or

more drinks on the same occasion on at least 5 different days in the past 30 days). According to the 2001 National Household Survey of Drug Abuse, 63.7% of persons aged 12 years or older reported alcohol use during the past year. Although this was a significant increase compared to the 61.9% reported in 2000, it was well below the peak of 72.9% in 1979 (Foster *et al.* 2003, SAMHSA 2003). In 2002, 51% (about 120 million people) were current drinkers, 22.9% (about 54 million people) were binge drinkers, and 6.7% (about 15.9 million people) were heavy drinkers. The highest prevalence of both binge and heavy drinking was for young adults aged 18 to 25. In all age groups, except for the youngest age group (12 to 17), males were more likely than females to report past month alcohol drinking (SAMHSA 2003).

### Regulations and Guidelines

No specific regulations or guidelines relevant to reduction of exposure to alcoholic beverage consumption were identified

\*No separate CAS registry number is assigned to alcoholic beverages.

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