

1.1

Alcoholic Beverages of the World: An Introduction to the Contents of This Book

In many parts of the world, alcoholic beverages are an important part of day-to-day life. Their moderate consumption in a social environment is seen as a boon for both body and soul. Many are the proposals of marriage, forging of business partnerships and fruitful scientific discussions that have taken place through the centuries over a drink or two in a bar, or over dinner at home. It is not by chance that Francis Crick and James Watson celebrated their discovery of the double helix structure for DNA over pints of ale in the bar of The Eagle, an old coaching inn close to the centre of Cambridge. Indeed, public drinking places are more often than not meeting places: focal points for merriment, discussion, liaison and the sharing of dreams. From the cosy English country pub, the sunny German Biergarten and the elegant Parisian café to the tavernas of Italy and Greece, the small taverns high in the Andes, the bars of South Africa and the jumak of Korea, the multitudes of alcoholic drinks consumed in all these places are potent social lubricants.

There is truly a fantastic range of alcoholic beverages to enjoy – something to suit almost everyone for almost every occasion. At the heart of all alcoholic beverages is fermentation (Part 2), particularly alcoholic fermentation, whereby sugars are converted to ethanol and many other minor products (Chapters 2.1 and 2.2). Many different fungi are able to promote at least some conversion of sugar to ethanol, but in doing so they are often able to stamp their personalities on the beverage by producing characteristic flavor profiles (Chapter 2.2), thus contributing to the rich diversity of alcoholic drinks. Likewise malolactic bacteria, by performing malolactic fermentations under the right conditions, are able to positively influence the character of alcoholic beverages (Chapter 2.3). Fermentations caused by certain other bacteria or fungi can have undesirable influences on aroma and flavor (Chapter 2.4), but these are usually suppressed in favor of the action of desirable microorganisms by the use of antiseptics and preservatives such as sulfites (Chapter 2.5).

Beers are enjoyed all over the world: they are brewed according to many different recipes and procedures, giving many hundreds of different brands or styles, from pale Pilsners and wheat beers to brown ales, porters and stouts (Chapter 2.6). Beverages brewed from cereals other than barley or wheat, such as maize, millet and rice (and without the use of hops) are enjoyed by millions of people in Africa, Asia, and Central and South America (Chapter 2.7). Some general information on beer and cereal beverages, and where they are brewed can be found in Figures 1.1.1 and 1.1.2.

Cider and perry are produced in many countries in a wide range of styles and flavors by a variety of methods (Section 2.8). Although from a biochemical and sensory viewpoint, cider and perry are closer to wine than

4 Introduction, Background and History



2003 or 2004 Approximate beer production figures for selected European countries and the Russian Federation (in hl $\times 10^3$): Germany (106 300), Russian Federation (70 000), U.K. (58 000), Spain (28 000), Poland (26 000), Netherlands (25 000), Czech Republic (19 000), France (18 000), Belgium (17 400), Austria (9 000), Denmark (8 300), Ireland (8 000), Slovakia (4 700).

Hops are grown all over Europe, the best known areas being Bavaria (Germany), Bohemia (Czech Republic), Hereford (UK), Kent (UK) and Saxony (Germany).

Cider and perry is made in many European countries, especially in Brittany and Normandy (France); Asturias and Basque provinces (Spain); East Anglia, Hereford and Somerset (UK).

Pale Pilsner lagers are the most common. Ales are brewed in Belgium, the British Isles, northern France and Germany. Wheat beers (Belgium and Germany) are top fermented, as are the porters and stouts of the UK and Ireland. Baltic porters and stouts are bottom fermented, as a rule. Belgium, Germany and the UK still have relatively large numbers of smaller breweries. Malted barley dominates, but there are wheat beers, rye beers (Germany) and oatmeal stouts (UK).

Europe has some traditional brews that pre-date modern beer styles. These are found in the Baltic countries, especially Finland (sahti) and Estonia (koduõlu).

Russia produces mostly pale lager beers, but there are some good dark beers; porters and stouts, mostly bottom fermented.

Some characterful lager style beers are brewed in Asia, especially in China, India and the Philippines.

Asia has many indigenous cereal-based brews, such as makkoli (Korea) and sake (Japan).

Africa has many cereal based indigenous brews, such as shakporo and pombe. Almost every state has at least one brewery owned by a European or multinational company, usually focusing on pale lagers.

Australia and New Zealand produce mostly pale lagers, brewed by big companies in modern breweries. There are also some admirable ales and stouts brewed. Some cider is produced in both countries.

Figure 1.1.1 Beer and Cider in Europe, Africa, Asia and Australasia. Thanks are due to Belhaven Brewery Ltd, Coopers Brewery Ltd, Domaine Familial L. Dupont, Hite Co., Jennings plc, Keo Ltd, Brasserie Lindemans, Nottingham Brewery Ltd, G. Schneider & Sohn GmbH and Whin Hill Cider for permission to use label and bottle images

Alcoholic Beverages of the World: An Introduction to the Contents of This Book 5



Like USA, Canada's beer market is dominated by pale lagers brewed by a handful of large companies. However, again like USA, there has been an upsurge in the brewing of ales and special lagers by a rapidly growing number of microbreweries and brewpubs since the 1990s. Cider and perry are made in nearly all the states, especially Quebec and British Columbia.

USA can be considered to be the world's prime brewing nation. Not only is the country the biggest producer of beer and the home of one of the largest brewing companies (Anheuser Busch), but also has the widest range of beer styles (although these are not necessarily universally available). Many of these styles are derived from European styles and are brewed mostly by smaller regional and (especially) by the hundreds of microbreweries and brewpubs that have sprung up since the 1980s. Although pale Pilsner style lagers dominate the everyday market, the beer drinker will find a huge range of ales of all strengths, colors and flavors, as well as wheat beers and high quality lagers. Many of these beers, however, are not widely distributed. Light beers are popular in USA and Canada. Cider and perry are produced in many states, by both large and small companies. Good cider is made from indigenous apples, but also nowadays from European cider apples.

Hops are grown extensively in Oregon, Washington State and British Columbia. They are also grown in some eastern states, such as Vermont.

The Caribbean islands produce some characterful lagers and stouts.

Central and South America produce mainly pale lagers from a relatively small number of large breweries. Mexico is one of the biggest exporters of beer: much of it going to the USA. There are many indigenous brews, such as chicha, usually made from maize and other grains. Two of the biggest drinks companies (which includes brewing companies) are partly Brazilian-owned. Cider is produced in some South American countries.

Figure 1.1.2 *Beer and cider in the Americas. Thanks are due to the Alaskan Brewing Co., Farnham Hill Cider, Firestone Walker Brewing Co., McAuslan Brewing Inc., New Belgium Brewing, Red Hook Ale Brewery, Scotch-Irish Brewing, Sierra Nevada Brewing Co. and Vancouver Island Brewery for permission to use label images*

6 Introduction, Background and History

beer, socially they are closer to beer, and so for the latter reason general information on these two drinks can be found in Figures 1.1.1 and 1.1.2, alongside beers.

Wines are similarly enjoyed throughout the world, produced in a wide range of styles from many vine varieties by numerous methods. They range from light sparkling wines and still, dry white wines through rosé, red and sweet, white table wines (Chapter 2.9) to fortified wines (Chapter 2.10) and fortified/flavored wines (Chapter 2.12). These are all made from grapes and some general facts concerning their production and styles are given in Figures 1.1.3 and 1.1.4. Wines from fruit other than grapes or even from vegetables, flowers, honey or sap (Chapter 2.11) are made in many parts of the world: general information on these drinks can be also be found in Figures 1.1.3 and 1.1.4.

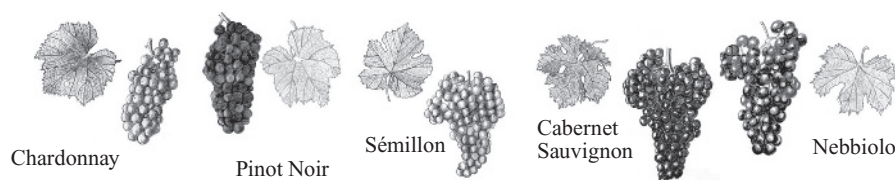
Apart from the multitude of biochemical reactions that occur during fermentation, important biochemical, chemical and physical processes occur at other stages during the manufacture of alcoholic drinks. Included here is the boiling process in the brewing of beer (Section 2.6.3); different wine maturation processes, such as those for fino Sherry (Section 2.10.3) and Madeira (Section 2.10.6); clarification processes (centrifugation, filtration and fining) and pasteurization (see for example Sections 2.6.9, 2.8.5, 2.8.6, 2.9.4, 3.2.5); and blending and packaging (see Sections 2.6.10, 2.10.2 and 3.2.5).

Certain alcoholic beverages are brewed specifically for distillation, which converts them into distilled beverages or spirits (Part 3). These are produced using a variety of distillation techniques and a range of types of stills (Chapter 3.1). Thus malted cereal beverages are used to produce Scotch whisky (Chapter 3.2) and other whiskeys (Chapter 3.3), as well as a number of other distilled drinks (Chapter 3.4) such as akvavit, gin and vodka. Canes, roots, tubers and saps can also be used to make distilled beverages, such as arrack, rum, schnapps and tequila (Chapters 3.5 and 3.8). Brandy is distilled wine and is produced in nearly all wine-producing countries (Chapters 3.6 and 3.7). Likewise, fruit wines such as plum wine or cherry wine can be converted to fruit brandies such as slivovitz and kirsch (Chapter 3.8) and spirits like brandy, gin or Scotch whisky can be infused with fruit, herbs or spices and (often after redistillation), sweetened with sugar or honey to make liqueurs (Chapter 3.9). Figures 1.1.5 and 1.1.6 give some general information on the wide variety of distilled beverages and where they are made.

Science and technology now play major roles at all stages in the production of most alcoholic drinks – from genesis in the barley field, hop garden, orchard or vineyard, through manufacture by fermentation, distillation and other processes to maturation, clarification, blending and packaging. Quality assurance and control have elevated the overall quality of many beverages to consistently high levels (Section 1.2.5). The analytical methods that are used for the maintenance of quality are described in Part 4. Many of these techniques also increase our knowledge and understanding of the various materials and processes involved in alcoholic drinks production, as well as helping the brewer or winemaker to maximize the quality of his or her product. The biological and chemical natures of the raw materials (Sections 2.6.2, 2.6.3, 2.8.2, 2.11.2, 2.12.2, 3.2.2, for example) are of prime importance in the making of alcoholic beverages, as is the chemical composition of the finished product, particularly with regard to sensory analysis (Chapter 4.7). The quality and authenticity of a beverage can often be judged by the absence or presence (and relative quantity) of certain constituents, as determined by one or more of the numerous methods described in Part 4: by chromatographic (Chapter 4.3), spectroscopic (Chapter 4.4) or electrochemical methods (Chapter 4.5), for example.

The levels of many alcoholic beverage components are now subject to legislative restriction, which means samples must be checked by government or approved laboratories from time to time to ensure such components are present below their maximum allowed levels or maximum residue levels (MRLs). Many producers also perform analyses throughout the production process, as part of their quality assurance programs. These components include some that are added deliberately as part of the production process (additives; see Chapter 5.9 and plant flavorings; see Chapters 2.12 and Sections 3.9.3 and 5.11.2), as well as some that are derived from the basic raw materials (e.g. nitrogenous allergenic substances, Section 5.11.3) and some,

Alcoholic Beverages of the World: An Introduction to the Contents of This Book 7



There are small wine industries in the UK, Belgium, Ireland, the Netherlands and even southern Scandinavia. Good wines are made, often in state of the art wineries from *Vitis vinifera* crosses and hybrids that have been bred for cool climates. These include Bacchus, Huxelrebe, Kerner, Müller Thurgau, Schönburger and Seyval Blanc. Classic varieties like Pinot Noir and Chardonnay are used to make very good sparkling wines by the Champagne method. Fruit wines are made in several northern European countries.

Wine production (2005) (hl $\times 10^3$)

France 52 004 Australia 14 000

Italy 50 556 China 12 336

Spain 34 750 Germany 9 100

South Africa 8 400 Moldova 3 200

Vineyard area

(2005)

(acres $\times 10^3$)

Spain 2990

France 2134

Italy 2110

Turkey 1400

China 1150

Moldova 399



France produces the biggest quantities of the world's finest wines; nearly all the great wine styles have French origins. This includes Burgundy (Chardonnay, Gamay Noir and Pinot Noir), Bordeaux (Cabernets, Merlot Noir, Sauvignon Blanc and Sémillon), the Rhone valley (Syrah for red, Marsanne, Roussane and Viogner for white), Alsace (mainly dry white wines), the Loire valley (light reds to sweet whites). Vermouth and fortified wines (e.g. Muscat de Lunel) are also made. Spain and Portugal produce a wide range of wines, from dry white to sweet red, including the great fortified wines, Madeira, Port and Sherry. Italy is the home of some great red wines, like Barolo in the north and Brunello di Montalcino further south. Italy also produces the unique styles of reciottio and ripasso. Vermouth and the fortified Marsala are also made. Germany, along with Alsace, make great wines from the Rheinriesling. Other countries of central, southern and eastern Europe also make good wines in many styles (e.g. Tokay of Hungary). Fruit wines are made all over Europe, but much of it is distilled (see Figure 1.1.5).

Australia has a large number of wineries that produce some great red wines, like Penfold's Grange, made from classic varieties such as Cabernet Sauvignon and Shiraz (Syrah). There are also good white wines made from Chardonnay, Rheinriesling, Sémillon and others, as well as great fortified Muscat wines. New Zealand makes some especially flavory white wines from Gewürztraminer and Sauvignon Blanc, and also lighter red wines from Cabernets and Pinot Noir. Hybrids are still grown in New Zealand.

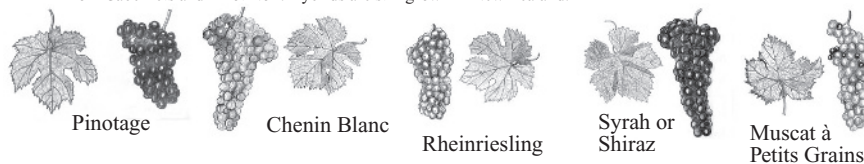
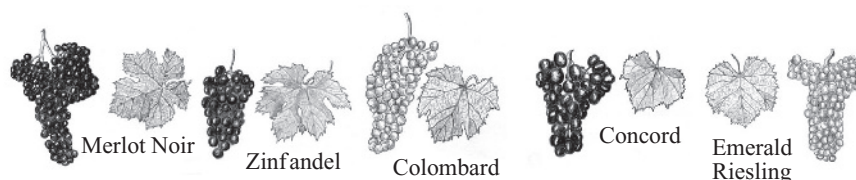


Figure 1.1.3 Wine in Europe, Africa, Asia and Australasia

8 Introduction, Background and History



Fruit wines, from pomegranate, through cherry to black raspberry are made throughout Canada and USA, even in states with extensive vineyard areas, such as California and New York.

Many eastern, central and southern states produce wine from native American varieties such as Catawba, Concord, Delaware, Niagara, Noah and Scuppernon. Wines are also made from French-American hybrids, such as Baco Noir, Cascade, de Chaunac and Marechal Foch.

Wine production (2005)
(hl $\times 10^3$)
Argentina 15 222
Brazil 3200
Chile 7890
USA 28 750

Vineyard area (2005)
(acres $\times 10^3$)
Argentina 520
Brazil 170
Chile 465
USA 935

California, Oregon, Washington and British Columbia produce a wide range of wines, including *V. vinifera* sparkling wines and fortified wines. California makes some world class wines, mainly from classic *V. vinifera* varieties, like Cabernet Sauvignon, Chardonnay and Pinot Noir. *V. vinifera* crosses, like Ruby Cabernet, and less well known varieties, like Zinfandel can also give very good wines.

Mexico produces some good wine, mainly from warm climate *V. vinifera* varieties, like Syrah.

Vineyards close to the Great Lakes or the Finger Lakes make wine from French-American hybrids and increasingly from *V. vinifera* varieties, like Chardonnay and Rheinriesling.

Although the Spanish colonized Chile, the major influence on the Chilean wine industry is Italian (through immigrants), French and lately, Californian. The very large Argentinian wine industry also owes much to Italian immigrants. Very good wines are made from classic varieties, such as Cabernet Sauvignon, Chardonnay, Merlot and Sauvignon Blanc. Argentina also makes wine from Malbec, as well as Barbera and other Italian varieties. Some South American states produce wine from other fruits, such as blackberry.

Argentina, Brazil and Chile are the most important wine producers of South America. Wine is still made from hybrids in Brazil, because of the hot, humid climate. Uruguay makes good wine from less common *V. vinifera* varieties, like Gewürztraminer and Tannat.

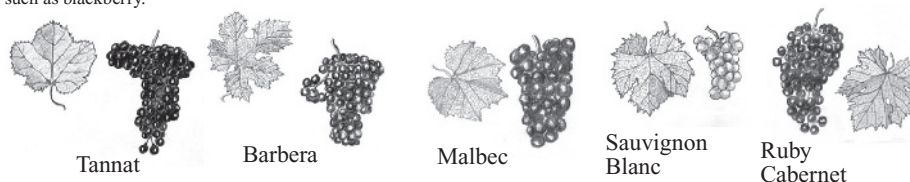


Figure 1.1.4 Wine in the Americas

Alcoholic Beverages of the World: An Introduction to the Contents of This Book 9



Brandy (distilled wine) is the major spirit of mainland Europe. Cognac and Armagnac are the finest and best known, but brandy is made in nearly all wine growing countries, from Spain to the Balkan countries of Greece and the former Yugoslavia. Grape pomace spirit is made in France (marc) and Italy (grappa) in particular. Fruit brandies and liqueurs (many brandy-based) are produced all over Europe. The former from Alsace are especially fine, but good fruit brandies are also made in Greece and the former Yugoslavia.

In northern Europe, akvavit (also called schnapps) is popular. It is distilled from grains, roots or even fruit and is usually flavored with herbs.

Vodka is a similar drink that is produced in Finland, Poland, other Baltic states and Russia. It is made mainly from cereals and is sold mostly unflavored, often being used in cocktails and mixes. There are flavored versions of vodka. Gin is made in the Netherlands, as are some liqueurs (e.g. cherry brandy). Russia produces brandy in the south of the country.

Scotch whisky is the most noted spirit of the British Isles: it is exported all over the world, mainly as blends and single malts. The styles range from the light Lowland whiskies, through fuller bodied highland whiskies, to the heavily peated Island whiskies. Irish Whiskey also finds world wide popularity and can be increasingly found as single malts. The Isle of Man and Wales also produce small amounts of whisky. Gin is distilled in London and Plymouth. Tiny amounts of brandy and apple brandy are made. There is small range of liqueurs, good examples being sloe gin and the Scotch whisky-based Drambuie.

Arrak and similar spirits are made from a variety of sources (e.g. date fruit, palm sap) in several Middle-Eastern countries, such as Egypt and Lebanon.

Spirits are produced from cereals (especially rice) and roots all over Eastern Asia (e.g. soju of Korea and shochu of Japan). Some are flavored (e.g. with ginseng). Many fruit and other liqueur wines are also made here. Rum is made in Indonesia (especially Batavia) and the Philippines.

Production of spirits in Africa is more or less limited to South Africa, where good brandy is made.

Figure 1.1.5 *Spirits in Europe, Africa, Asia and Australasia. Thanks are due to Familial Dupont, Kilchoman Distillery Co. Ltd., Keo Ltd., Glengoyne Distillery and The Rum Story, for permission to use label and bottle images*

such as ethyl carbamate (Section 5.11.5) that are sometimes formed during the manufacturing process. Also included here are pesticide residues and various other contaminants (Chapter 5.10).

It has long been known that alcoholic beverages possess nutritional and health values, in both positive (beneficial) and negative (detrimental) senses (Part 5). As public awareness and interest in nutrition and health issues have grown during the past two or three decades, so scientific interest in the nutritional value

10 Introduction, Background and History

During the last decade there has been a marked growth in microdistilleries, especially in the USA. These distilleries produce a wide range of spirits, although mostly from grains: gin, rum, vodka and whiskeys of various styles, mostly using batch column or pot stills.

Whiskey (whisky in Canada), is distilled all over North America, from mainly mixed grain mashies, although maize (corn) dominates the whiskeys of USA; wheat is more important in Canada. Bourbon is made from at least 51% maize, with barley and rye. The whiskeys of Kentucky, Tennessee and Virginia are probably the most famous, but much Canadian whisky is consumed in the USA. Straight rye and corn whiskeys are making a modest resurgence in the USA and Canada (rye). Distilling is mostly by batch and continuous column stills, but a few pot stills are in use.



Tequila is the major spirit of Mexico, although brandy and rum are also produced. Tequila and mezcal are made from fermented *Agave* pulp and are much exported, especially to the USA.

Many of the South American states are wine producers and so also make brandy. Perhaps the best known brandy is pisco, made from Muscat wine in Peru, and from other wines in Chile.



The Carribean countries produce much of the world's best rum. Light rum for mixed drinks and cocktails is made throughout the area, but is typified by those from Cuba and Puerto Rico. Likewise, Heavier darker rums are produced everywhere, but those of Demerara, Jamaica and Martinique are the best known. Both pot stills and continuous stills are used.

Cachaca is the cane spirit of Brazil. It is still produced by hundreds of small to medium distilling companies and its exports are rising. Pot stills, as well as batch and continuous column stills are used. Brazil grows much of the sugar cane used for Carribean rum.

Figure 1.1.6 Distilled spirits and liqueurs in the Americas

of alcoholic drinks and their components has increased (Chapters 5.1–5.5). Several alcoholic drinks are important for their macronutrients such as carbohydrates (Chapters 5.3 and 5.7) and many possess significant quantities of micronutrients (Chapter 5.4) and 'prebiotic' components, such as oligosaccharides, lactic acid bacteria and yeast. Ethanol, although it has a high calorific value itself, its presence in the diet can negatively influence uptake and metabolism of nutrients (Chapter 5.5). The past 10 years in particular have also witnessed a rapid growth in scientific interest in the health values of specific components of beverages, notably ethanol (Chapter 5.6), carbohydrates (Chapter 5.7), phenolic compounds (Chapter 5.8), additives (Chapter 5.9)

and trace components (Chapter 5.11). Similarly, growth in public interest in health, safety, pollution and environmental issues has catalyzed increased scientific activity in the study of pesticide residues and other contaminants of alcoholic beverages and the raw materials from which they originate (Chapter 5.10).

The various alcoholic drinks industries are important parts of the food and drinks industry: they contribute to a nation's economic prosperity to a significant degree. Indeed in some countries, such as several in the Caribbean area, the contribution is a major one. Moreover, the alcoholic drinks industries support numerous other diverse industries, like glass, plastics, cork, engineering and tourist industries. Additionally, agriculture has important ties with the alcoholic drinks industries: the growing of barley and other cereals for beer and spirits production, hops for the brewing of beer, apples for cider making, grapes for the production of wine and brandy, sugar cane for making rum and so on. Forestry provides cork, oak or chestnut wood to make casks for the maturation of wine or spirits and other kinds of timber to produce stakes for the support of crops such as grapevines.

According to the Wine Institute of California, in 2008, the wine industry in that state provided 309 000 jobs, produced an annual \$51.8 billion in economic value for that state, generated \$125.3 billion for the US economy, paid \$10.1 billion in wages in California (\$25.2 billion nationwide), made \$13 billion in state and federal tax payments, attracted 19.7 million tourists per annum and generated wine-related tourism expenditures of \$2 billion in California. The Californian wine industry also gives \$115 million in annual charitable contributions and offers numerous intangible benefits to local communities, such as (amongst other things) enhancing the general quality of life, bringing positive visibility to the community, building local pride, offering cultural attractions, supporting local businesses, promoting responsible farming and winemaking, and providing scenic pastoral landscapes. The Californian wine industry can reasonably be regarded as a microcosm of the alcoholic beverage industry as a whole, where wineries, breweries and distilleries all over the world play similar roles in support of their local and national communities. Although the alcoholic drinks industry per se is not discussed in detail in this book, its presence obviously permeates the text of Parts 2 and 3 in particular, and also to a lesser extent that of Part 5.