Fermented and Distilled Beverages
Nectar of the Gods?

Cabernet Sauvignon

Chardonnay
Fermenting and Distillation

Transformation and preservation of fruit and grain into intoxicating beverages.
Gave rise to science of microbiology
Wines, beers and distilled liquors
Anaerobic (no oxygen) fermentation is conversion of sugar to alcohol:
\[ C_6H_{12}O_6 \rightarrow 2 C_2H_5OH + 2 CO_2 \]
Distillation concentrates the ethanol in the solution based on different boiling points of ethanol and water.
Background on alcoholic fermentation

Prehistoric, so we don’t know what the first alcoholic beverage was or how it was made though beer is good guess.

Yeast produce alcohol as a by-product of obtaining chemical energy from sugars.

Wild fruits had little sugar and were not best suited for fermentation. Earliest beverages are thought to have been made from honey (mead), dates or sap from palm trees (palm wine).

With domestication of plants, selecting sweeter varieties of fruit, beverages were made from these – grapes became fruit of choice for making wine.
Grapes for wine

*Vitis vinifera*, the most common of 30 species of *Vitis* used today had its origins in central Asia, but was developed in Mesopotamia and Egypt. Because it could easily be grown, it soon spread to Mediterranean area.

Most grapes are used in wine production. Several US species have contributed genes for rootstocks for pest resistance – such as root aphid phylloxera and cold hardiness- collectively known as French-American hybrids.
World Production

2009  27 M mt
Italy  5.0 M mt
France 4.6 M mt
Spain  3.2 M mt
USA    2.2 M mt
Argentina 1.2 M mt
China   1.6 M mt
Grape botany

Woody perennial vine, flowering on new wood, producing berries in clusters.

Propagation by cuttings or grafted onto rootstocks for disease and pest control.

Oldest vine in California planted 1765
Grape harvest
Grapes are harvested for wine by hand with pruners & knives or machines.
Basic wine production

Crush, squeeze, strain

Ferment with natural or kill all microorganisms with sulfites and use cultured yeast, force anaerobic conditions with air lock

Age in oak, stainless steel, glass
Bittenbender, visiting scientist and his MS advisor, G. Stan Howell, Professor of Horticulture at Michigan State University and father of the modern wine industry in Michigan, 1982
Distillation- basic modern method

- Boil beer or wine after fermentation has stopped.
- Condense vaporized ethanol on a cool surface.
- Collect liquid ethanol.

Ethanol vapor

Cool water enters condenser coils.
Warm water exits.
Ethanol liquid

Beer/wine
Heat
Distillation the old way

Condenser with cool water

Vapor chamber, holes for entry

Beer or wine in pot over fire

Collection pot for ethanol, goes here

This system is still used in Nepal to make roxi distilled from rice beer (wine) and may be of Chinese or Indian origin.
Distilled beverages

Essentially anything that can be fermented to alcohol can be distilled.

Brandy is made from any fruit wine, cognac is made chardonnay wine in the cognac region of France, aged in oak.

Whiskey is made from fermented grain beer-barley, corn, rye, rice.

Vodka from fermented potato juice but grains as well. okolehao from ti stump.
Okolehao

Distilled from fermented baked ti (Cordyline terminalis) roots, generally 40 to 60% alcohol. Ti is canoe plant that was likely brought as cooking utensil rather than used a food. Speculation that ti was used as precontact ‘beer’. Its distillation awaited the English. Its name refers to the iron pots used to render whale oil. Two of large, round cast iron pots side-by-side resembled a butt, so the liquor was nicknamed ‘iron butt’ or okole hao.

Best distiller was Roy Bradley, marine who stayed after WWI. He used pineapple juice and yeast and aged it in oak barrels. His product is considered of cognac quality.
Sake

Sake is Japanese rice ‘beer’ that uses a fungus Asperigillus oryzae, that grows on the highly polished, soaked rice to provide enzymes that convert the rice starch into sugar. Rice lacks the amylase enzyme found in large quantities in barley. After 5 days water and yeast is added, but no hops.
Fortified wines

Sherry from the Arabic name *Sherish* for the main town in the south of Spain. It is made a the Palomino grape variety. After fermentation, alcohol is added to reach 15 to 17 %. It is aged in oak.

Port is made in Portugal and named after the city of Porto and the alcohol is added to stop fermentation. But countries produce ‘port’ style wines that are called port but cannot be sold in Portugal.