

# Smoking (cooking)

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**Smoking** is the process of flavoring, browning, cooking, or preserving food by exposing it to smoke from burning or smoldering material, most often wood. Meats and fish are the most common smoked foods, though cheeses, vegetables, and ingredients used to make beverages such as whisky,<sup>[1]</sup> smoked beer, and *lapsang souchong* tea are also smoked.

In Europe, alder is the traditional smoking wood, but oak is more often used now, and beech to a lesser extent. In North America, hickory, mesquite, oak, pecan, alder, maple, and fruit-tree woods, such as apple, cherry, and plum, are commonly used for smoking. Other biomass besides wood can also be employed, sometimes with the addition of flavoring ingredients. Chinese tea-smoking uses a mixture of uncooked rice, sugar, and tea, heated at the base of a wok.

Some North American ham and bacon makers smoke their products over burning corncobs. Peat is burned to dry and smoke the barley malt used to make whisky and some beers. In New Zealand, sawdust from the native manuka (tea tree) is commonly used for hot smoking fish. In Iceland, dried sheep dung is used to cold-smoke fish, lamb, mutton and whale.

Historically, farms in the Western world included a small building termed the *smokehouse*, where meats could be smoked and stored. This was generally well-separated from other buildings both because of the fire danger and because of the smoke emanations.

The smoking of food directly with wood smoke is known to contaminate the food with carcinogenic polycyclic aromatic hydrocarbons.<sup>[2]</sup>



Meat hanging inside a smokehouse in Switzerland.



A Montreal Smoked Meat Sandwich, a well-known Canadian dish.



Hot-smoked chum salmon

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## History

The smoking of food dates back to the time of primitive cavemen.<sup>[3][4]</sup> As caves or simple huts lacked chimneys, these dwellings could become very smoky. The early men would often hang meat up to dry, and they soon became aware that meat that was stored in smoky areas acquired a different flavor and was better preserved than meat that simply dried out. Over time this process was combined with pre-curing the food in salt or salty brines, resulting in a remarkably effective preservation process that was adapted and developed by numerous cultures around the world.<sup>[5]</sup> Until the modern era, smoking was of a more "heavy duty" nature as the main goal was to preserve the food. Large quantities of salt were used in the curing process and smoking times were quite long, sometimes involving days of exposure.<sup>[3]</sup>

The advent of modern transportation made it easier to transport food products over long distances and the need for the time and material intensive heavy salting and smoking declined. Smoking became more of a way to flavor than to preserve food. In 1939 a device called the Torry Kiln was invented at the Torry Research Station in Scotland. The kiln allowed for uniform mass-smoking and is considered the prototype for all modern large-scale commercial smokers. Although refinements in technique and advancements in technology have made smoking much easier, the basic steps involved remain essentially the same today as they were hundreds if not thousands of years ago.<sup>[3]</sup>

## Types

### Cold smoking

Smokehouse temperatures for cold smoking are typically done between 20 to 30 °C (68 to 86 °F).<sup>[6]</sup> In this temperature range, foods take on a smoked flavor, but remain relatively moist. Cold smoking does not cook foods. Meats should be fully cured before cold smoking.<sup>[6]</sup> Cold smoking can be used as a flavor enhancer for items such as chicken breasts, beef, pork chops, salmon, scallops, and steak. The item is hung first to develop a pellicle, then can be cold smoked for just long enough to give some flavor. Some cold smoked foods are baked, grilled, steamed, roasted, or sautéed before eating.



A "Little Chief" home smoker and racks with hot smoked Pacific halibut

## Hot smoking

Hot smoking exposes the foods to smoke and heat in a controlled environment. Like cold smoking, the item is hung first to develop a pellicle, then smoked. Although foods that have been hot smoked are often reheated or cooked, they are typically safe to eat without further cooking. Hams and ham hocks are fully cooked once they are properly smoked. Hot smoking occurs within the range of 52 to 80 °C (126 to 176 °F).<sup>[6]</sup> Within this temperature range, foods are fully cooked, moist, and flavorful. If the smoker is allowed to get hotter than 185 °F (85 °C), the foods will shrink excessively, buckle, or even split. Smoking at high temperatures also reduces yield, as both moisture and fat are "cooked" away.

## Smoke roasting

Smoke roasting or "smoke baking" refers to any process that has the attributes of smoking combined with either roasting or baking. In North America, this smoking method is commonly referred to as "barbecuing", "pit baking", or "pit roasting". It may be done in a smoke roaster, closed wood-fired masonry oven or barbecue pit, any smoker that can reach above 180 °F (82 °C), or in a conventional oven by placing a pan filled with hardwood chips on the floor to smolder and produce a smoke bath.

## Wood smoke

Hardwoods are made up mostly of three materials: cellulose, hemicellulose, and lignin. Cellulose and hemicellulose are the basic structural material of the wood cells; lignin acts as a kind of cell-bonding glue. Some softwoods, especially pines and firs, hold significant quantities of resin, which produces a harsh-tasting soot when burned; these woods are not often used for smoking.

Cellulose and hemicellulose are aggregate sugar molecules; when burnt, they effectively caramelize, producing carbonyls, which provide most of the color components and sweet, flowery, and fruity aromas. Lignin, a highly complex arrangement of



Hickory-smoked country-style ribs.

interlocked phenolic molecules, also produces a number of distinctive aromatic elements when burnt, including smoky, spicy, and pungent compounds such as guaiacol, phenol, and syringol, and sweeter scents such as the vanilla-scented vanillin and clove-like isoeugenol. Guaiacol is the phenolic compound most responsible for the "smokey" taste, while syringol is the primary contributor to smokey aroma.<sup>[7]</sup> Wood also contains small quantities of proteins, which contribute roasted flavors. Many of the odor compounds in wood smoke, especially the phenolic compounds, are unstable, dissipating after a few weeks or months.

A number of wood smoke compounds act as preservatives. Phenol and other phenolic compounds in wood smoke are both antioxidants, which slow rancidification of animal fats, and antimicrobials, which slow bacterial growth. Other antimicrobials in wood smoke include formaldehyde, acetic acid, and other organic acids, which give wood smoke a low pH—about 2.5. Some of these compounds are toxic to people as well, and may have health effects in the quantities found in cooking applications.

Since different species of trees have different ratios of components, various types of wood do impart a different flavor to food. Another important factor is the temperature at which the wood burns. High-temperature fires see the flavor molecules broken down further into unpleasant or flavorless compounds. The optimal conditions for smoke flavor are low, smoldering temperatures between 570 and 750 °F (299 and 399 °C). This is the temperature of the burning wood itself, not of the smoking environment, which uses much lower temperatures. Woods that are high in lignin content tend to burn hot; to keep them smoldering requires restricted oxygen supplies or a high moisture content. When smoking using wood chips or chunks, the combustion temperature is often raised by soaking the pieces in water before placing them on a fire.

## Types of smoker

### Charcoal

#### Offset

The main characteristics of the offset smoker are that the cooking chamber is usually cylindrical in shape, with a shorter, smaller diameter cylinder attached to the bottom of one end for a firebox. To cook the meat, a small fire is lit in the firebox, where airflow is tightly controlled. The heat and smoke from the fire is drawn through a connecting pipe or opening into the cooking chamber.

The heat and smoke cook and flavor the meat before escaping through an exhaust vent at the opposite end of the cooking chamber. Most manufacturers' models are based on this simple but effective design, and this is what most people picture when they think of a "BBQ smoker." Even large capacity commercial units use this same basic design of a separate, smaller fire box and a larger cooking chamber.



An example of a common offset smoker.

## Upright drum

The upright drum smoker (also referred to as an ugly drum smoker or UDS) is exactly what its name suggests; an upright steel drum that has been modified for the purpose of pseudo-indirect hot smoking. There are many ways to accomplish this, but the basics include the use of a complete steel drum, a basket to hold charcoal near the bottom, and cooking rack (or racks) near the top; all covered by a vented lid of some sort. They have been built using many different sizes of steel drums, such as 30 US gallons (110 l; 25 imp gal), 55 US gallons (210 l; 46 imp gal), and 85 US gallons (320 l; 71 imp gal) for example, but the most popular size is the common 55 gallon drum.

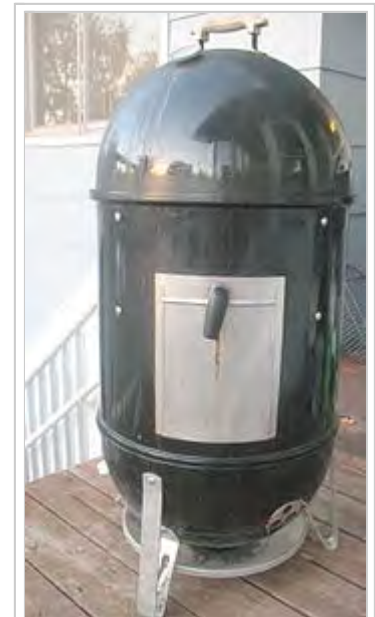


A diagram of a typical upright drum smoker

This design is similar to smoking with indirect heat due to the distance from the coals and the racks (typically 24 inches (61 cm)). The temperatures used for smoking are controlled by limiting the amount of air intake at the bottom of the drum, and allowing a similar amount of exhaust out of vents in the lid. UDSs are very efficient with fuel consumption and flexible in their abilities to produce proper smoking conditions, with or without the use of a water pan or drip pan. Most UDS builders/users would say a water pan defeats the true pit BBQ nature of the UDS, as the drippings from the smoked meat should land on the coals, burning up, and imparting a unique flavor one cannot get with a water pan.

## Vertical water

A vertical water smoker (also referred to as a bullet smoker because of its shape)<sup>[8]</sup> is a variation of the upright drum smoker. It uses charcoal or wood to generate smoke and heat, and contains a water bowl between the fire and the cooking grates.<sup>[8]</sup> The water bowl serves to maintain optimal smoking temperatures<sup>[8]</sup> and also adds humidity to the smoke chamber. It also creates an effect in which the water vapor and smoke condense together, which adds flavor to smoked foods.<sup>[8]</sup> In addition, the bowl catches any drippings from the meat that may cause a flare-up. Vertical water smokers are extremely temperature stable and require very little adjustment once the desired temperature has been reached. Because of their relatively low cost and stable temperature, they are sometimes used in barbecue competitions where propane and electric smokers are not allowed.



A typical vertical water smoker

## Propane

A propane smoker is designed to allow the smoking of meat in a somewhat more controlled environment. The primary differences are the sources of heat and of the smoke. In a propane smoker, the heat is generated by a gas burner directly under a steel or iron box containing the wood or charcoal that



A diagram of a propane smoker, loaded with country style ribs and pork loin in foil.

provides the smoke. The steel box has few vent holes, on the top of the box only. By starving the heated wood of oxygen, it smokes instead of burning. Any combination of woods and charcoal may used. This method uses less wood.

## Smoke box

This more traditional method uses a two-box system: a fire box and a food box. The fire box is typically adjacent or under the cooking box, and can be controlled to a finer degree. The heat and smoke from the fire box exhausts into the food box, where it is used to cook and smoke the meat. These may be as simple as an electric heating element with a pan of wood chips placed on it, although more advanced models have finer temperature controls.

## Commercial smokehouse

Commercial smokehouses, mostly made from stainless steel, have independent systems for smoke generation and cooking.

Smoke generators use friction, an electric coil or a small flame to ignite sawdust on demand. Heat from steam coils or gas flames is balanced with live steam or water sprays to control the temperature and humidity. Elaborate air handling systems reduce hot or cold spots, to reduce variation in the finished product. Racks on wheels or rails are used to hold the product and facilitate movement.

## Preservation

Smoke adds flavor, and is both an antimicrobial and antioxidant, but since it does not actually penetrate far into meat or fish is insufficient alone for preserving food; it is thus typically combined with salt-curing or drying.

Smoking is especially useful for oily fish, as its antioxidant properties inhibit surface fat rancidification and delay interior fat exposure to degrading oxygen. Some heavily-salted, long-smoked fish can keep without refrigeration for weeks or months.

Artificial smoke flavoring (such as liquid smoke) can be purchased to mimic smoking's flavor, but not its preservative qualities.

## Smoked foods and beverages

Some of the more common smoked foods and beverages include:



Smoked omul fish, endemic to Lake Baikal in Russia, on sale at Listyanka market.

## Beverages

- *Lapsang souchong* tea leaves are smoked and dried over pine or cedar fires
- Malt beverages
  - The malt used to make whisky
  - Rauchbier (smoked beer)

## Fruit and vegetables

- Capsicums: chipotles (smoked, ripe jalapeños), paprika
- Prunes (dried plums) can be smoked while drying
- *Wumei* are smoked plum fruits
- *Iburi-gakko* are a smoked daikon pickle from Akita Prefecture, Japan

## Meat, fish, and cheese

- Beef
  - Pastrami (pickled, spiced and smoked beef brisket)
- Pork
  - Bacon
  - Ham
  - Bakkwa
- Turkey
- Sausage
- Jerky
- Fish
  - Eel popular in eastern/northern Europe<sup>[9]</sup>
  - Traditional Grimsby smoked fish (cod and haddock)
  - Haddock and Arbroath Smokies (haddock)
  - Buckling, kippers and bloaters (herring)
  - Salmon
  - Mackerel
- Egg (eggs and fish eggs)
- Cheese
  - Gouda
  - Gruyère

## Other proteins

- Nuts
- Tofu

## Spices

- Paprika



Smoked Gruyère cheese



Fish being smoked in Tanji, The Gambia



Pastrami, a smoked and cured beef product

- Salt

## See also

- Braising
- Canning
- Drying
- Jerky
- List of dried foods
- List of sausage dishes
- List of sausages
- List of smoked foods
- Smoked fish
- Smoked meat

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## Further reading

- McGee, Harold (2004). "Wood Smoke and Charred Wood". *On Food and Cooking* (Revised ed.). Scribner. pp. 448–450. ISBN 0-684-80001-2.

## External links

- National Center for Home Food Preservation - How Do I...Cure & Smoke ([http://www.uga.edu/nchfp/how/cure\\_smoke.html](http://www.uga.edu/nchfp/how/cure_smoke.html))



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