

Vinegar

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Vinegar is a liquid consisting of about 5–20% acetic acid (CH_3COOH), water, and other trace chemicals, which may include flavorings. The acetic acid is produced by the fermentation of ethanol by acetic acid bacteria.^[1] Vinegar is now mainly used as a cooking ingredient, or in pickling. As the most easily manufactured mild acid, it has historically had a great variety of industrial, medical, and domestic uses, some of which (such as its use as a general household cleaner) are still commonly practiced today.

Commercial vinegar is produced either by fast or slow fermentation processes. In general, slow methods are used with traditional vinegars, and fermentation proceeds slowly over the course of months or a year.

The longer fermentation period allows for the accumulation of a nontoxic slime composed of acetic acid bacteria. Fast methods add mother of vinegar (bacterial culture) to the source liquid before adding air to oxygenate and promote the fastest fermentation. In fast production processes, vinegar may be produced in 20 hours to three days.



A variety of flavored vinegars on sale in France (bottom rows)

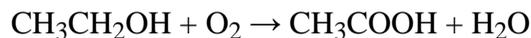
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Chemistry

The conversion of ethanol (CH₃CH₂OH) and oxygen (O₂) to acetic acid (CH₃COOH) takes place by the following reaction:^[2]



History

Vinegar has been made and used by people for thousands of years.^[3] Traces of it have been found in Egyptian urns from around 3000 BC.

Varieties

Apple cider

Apple cider vinegar is made from cider or apple must, and has a brownish-gold color. It is sometimes sold unfiltered and unpasteurized with the mother of vinegar present, as a natural product. It can be diluted with fruit juice or water or sweetened (usually with honey) for consumption as a health beverage.^[4]

Balsamic

Balsamic vinegar is an aromatic aged vinegar produced in the Modena and Reggio Emilia provinces of Italy. The original product—Traditional Balsamic Vinegar—is made from the concentrated juice, or must, of white Trebbiano grapes. It is very dark brown, rich, sweet, and complex, with the finest grades being aged in successive casks made variously of oak, mulberry, chestnut, cherry, juniper, and ash wood. Originally a costly product available to only the Italian upper classes, traditional balsamic vinegar is marked "tradizionale" or "DOC" to denote its Protected Designation of Origin status, and is aged for 12 to 25 years. A cheaper

non-DOC commercial form described as "aceto balsamico di Modena" (balsamic vinegar of Modena)^[5] became widely known and available around the world in the late 20th century, typically made with concentrated grape juice mixed with a strong vinegar, then coloured and slightly sweetened with caramel and sugar.

Regardless of how it is produced, balsamic vinegar must be made from a grape product. It contains no balsam fruit. A high acidity level is somewhat hidden by the sweetness of the other ingredients, making it very mellow.

Cane

Cane vinegar, made from sugarcane juice, is most popular in the Philippines, in particular, the Ilocos Region of the northern Philippines (where it is called *sukang iloko*), although it also is produced in France and the United States. It ranges from dark yellow to golden brown in color, and has a mellow flavor, similar in some respects to rice vinegar, though with a somewhat "fresher" taste. Because it contains no residual sugar, it is no sweeter than any other vinegar. In the Philippines, it often is labeled as *sukang maasim* (Tagalog for "sour vinegar").

Cane vinegars from Ilocos are made in two different ways. One way is to simply place sugar cane juice in large jars and it will become sour by the direct action of bacteria on the sugar. The other way is through fermentation to produce a local wine known as *basi*. Low-quality *basi* is then allowed to undergo acetic acid fermentation that converts alcohol into acetic acid. Contaminated *basi* also becomes vinegar.

A white variation has become quite popular in Brazil in recent years, where it is the cheapest type of vinegar sold. It is now common for other types of vinegar (made from wine, rice and apple cider) to be sold mixed with cane vinegar to lower the cost.

Sugarcane sirka is made from sugarcane juice in Punjab, India. During summer people put cane juice in earthenware pots with iron nails. The fermentation takes place due to the action of wild yeast. The cane juice is converted to vinegar having a blackish color. The sirka is used to preserve pickles and for flavoring curries.

Coconut

Coconut vinegar, made from fermented coconut water or sap, is used extensively in Southeast Asian cuisine (notably the Philippines), as well as in some cuisines of India and Sri Lanka, especially Goan cuisine. A cloudy white liquid, it has a particularly sharp, acidic taste with a slightly yeasty note.

Date

Vinegar made from dates is a traditional product of the Middle East .^{[6][7]}

Distilled

The term "distilled vinegar" (or "spirit vinegar" in the UK) is something of a misnomer when used in the US and North America, because it is not produced by distillation but by fermentation of distilled alcohol. The fermentate is diluted to produce a colorless solution of 5% to 8% acetic acid in water, with a pH of about 2.6. This is variously known as distilled spirit, "virgin" vinegar,^[8] or white vinegar, and is used in cooking, baking, meat preservation, and pickling, as well as for medicinal, laboratory, and cleaning purposes.^[9] The most common starting material in some regions, because of its low cost, is malt,^[10] or in the United States, corn (maize). It is sometimes derived from petroleum.^[11] Distilled vinegar in the UK is produced by the distillation

of malt to give a clear vinegar which maintains some of the malt flavour.^[10] Distilled vinegar is used predominantly for cooking, although in Scotland it is used as an alternative to brown or light malt vinegar. White distilled vinegar can also be used for cleaning.

East Asian black

Chinese black vinegar is an aged product made from rice, wheat, millet, sorghum, or a combination thereof. It has an inky black color and a complex, malty flavor. There is no fixed recipe, so some Chinese black vinegars may contain added sugar, spices, or caramel color. The most popular variety, Zhenjiang vinegar, originates in the city of Zhenjiang in Jiangsu Province, eastern China.^[12] Shanxi mature vinegar is another popular type of Chinese vinegar that is made exclusively from sorghum and other grains. Nowadays in Shanxi province, there are still some traditional vinegar workshops producing handmade vinegar which aged for at least five years with a high acidity. Only the vinegar made in Taiyuan and some counties in Jinzhong and aged for at least three years is considered authentic Shanxi mature vinegar according to the latest national standard.



Chinese black vinegar

A somewhat lighter form of black vinegar, made from rice, is produced in Japan, where it is called *kurozu*.

Fruit

Fruit vinegars are made from fruit wines, usually without any additional flavoring. Common flavors of fruit vinegar include apple, blackcurrant, raspberry, quince, and tomato. Typically, the flavors of the original fruits remain in the final product.

Most fruit vinegars are produced in Europe, where there is a growing market for high-price vinegars made solely from specific fruits (as opposed to non-fruit vinegars that are infused with fruits or fruit flavors).^[13] Several varieties, however, also are produced in Asia. Persimmon vinegar, called *gam sikcho*, is popular in South Korea. Jujube vinegar, called *zaocu* or *hongzaocu*, and wolfberry vinegar are produced in China.



Persimmon vinegar produced in South Korea

Honey

Vinegar made from honey is rare, although commercially available honey vinegars are produced in Italy, Portugal, France, Romania, and Spain.

Job's tears

In Japan, an aged vinegar also is made from Job's tears, a tall, grain-bearing, tropical plant. The vinegar is similar in flavor to rice vinegar.

Kiwifruit

A byproduct of commercial kiwifruit growing is a large amount of waste in the form of misshapen or

otherwise-rejected fruit (which may constitute up to 30 percent of the crop) and kiwifruit pomace, the presscake residue left after kiwifruit juice manufacture. One of the uses for this waste is the production of kiwifruit vinegar, produced commercially in New Zealand ^[14] since at least the early 1990s, and in China in 2008.^[15]

Kombucha

Kombucha vinegar is made from kombucha, a symbiotic culture of yeast and bacteria. The bacteria produce a complex array of nutrients and populate the vinegar with bacteria that some claim promote a healthy digestive tract, although no scientific studies have confirmed this. Kombucha vinegar primarily is used to make a vinaigrette, and is flavored by adding strawberries, blackberries, mint, or blueberries at the beginning of fermentation.

Malt

Malt vinegar, also called *alegar*, is made by malting barley, causing the starch in the grain to turn to maltose. Then an ale is brewed from the maltose and allowed to turn into vinegar, which is then aged. It is typically light-brown in color. In the United Kingdom and Canada, malt vinegar (along with salt) is a traditional seasoning for fish and chips, but some commercial fish and chip shops use non-brewed condiment.

Palm

Palm vinegar, made from the fermented sap from flower clusters of the nipa palm (also called attap palm), is used most often in the Philippines, where it is produced, and where it is called *sukang paombong*. It has a citrusy flavor note to it^[16] and imparts a distinctly musky aroma. Its pH is between five and six.

Pomegranate

Pomegranate vinegar (Hebrew: חומץ רימונים) is used widely in Israel as a dress for salad but also in meat stew and in dips.^[17]

Raisin



Raisin vinegar

Vinegar made from raisins, called *khall 'inab* (Arabic: خل عنب "grape vinegar") is used in cuisines of the Middle East, and is produced there. It is cloudy and medium brown in color, with a mild flavor.

Rice

Rice vinegar is most popular in the cuisines of East and Southeast Asia. It is available in "white" (light yellow), red, and black varieties. The Japanese prefer a light rice vinegar for the preparation of sushi rice and salad dressings. Red rice vinegar traditionally is colored with red yeast rice. Black rice vinegar (made with black glutinous rice) is most popular in China, and it is also widely used in other East Asian countries.

White rice vinegar has a mild acidity with a somewhat "flat" and uncomplex flavor. Some varieties of rice vinegar are sweetened or otherwise seasoned with

spices or other added flavorings.

Sherry

Sherry vinegar is linked to the production of sherrywines of Jerez. Dark-mahogany in color, it is made exclusively from the acetic fermentation of wines. It is concentrated and has generous aromas, including a note of wood, ideal for vinaigrettes and flavoring various foods.

Spirit

The term 'spirit vinegar' is sometimes reserved for the stronger variety (5% to 21% acetic acid) made from sugar cane or from chemically produced acetic acid.^[9] To be called "Spirit Vinegar", the product must come from an agricultural source and must be made by "double fermentation". The first fermentation is sugar to alcohol and the second alcohol to acetic acid. Product made from chemically produced acetic acid cannot be called "vinegar". In the UK the term allowed is "Non-brewed condiment".



Sherry vinegar

White

See Distilled vinegar.

Wine

Wine vinegar is made from red or white wine, and is the most commonly used vinegar in Southern and Central Europe, Cyprus and Israel. As with wine, there is a considerable range in quality. Better-quality wine vinegars are matured in wood for up to two years, and exhibit a complex, mellow flavor. Wine vinegar tends to have a lower acidity than white or cider vinegars. More expensive wine vinegars are made from individual varieties of wine, such as champagne, sherry, or pinot gris.

Uses

Culinary

Vinegar is commonly used in food preparation, in particular in pickling processes, vinaigrettes, and other salad dressings. It is an ingredient in sauces such as mustard, ketchup, and mayonnaise. Vinegar is sometimes used while making chutneys. It is often used as a condiment. Marinades often contain vinegar. In terms of its shelf life, vinegar's acidic nature allows it to last indefinitely without the use of refrigeration.^[18]

- Condiment for beetroot – cold, cooked beetroot is commonly eaten with vinegar and other ingredients
- Condiment for fish and chips (UK: chips; US: French fries) – in Britain, Ireland, Canada, and Australia, salt and malt vinegar is sprinkled on chips. In Canada, white vinegar is also often used.
- Flavoring for potato chips (UK: crisps) – many American, Canadian, British, and Australian manufacturers of packaged potato chips include a variety flavored with vinegar and salt.
- Vinegar pie – a North American variant on the dessert called chess pie. It is flavored with a small amount of cider vinegar and some versions also contain raisins, spices and sour cream.^[19]

- Pickling – any vinegar can be used to pickle foods.
- Cider vinegar and sauces – cider vinegar usually is not suitable for use in delicate sauces.
- Apple cider vinegar – Usually placed on the table in small bowls or cups so that people can dip their crab meat into it. Also mixed with water and used to steam crabs.^[20]
- Substitute for fresh lemon juice – cider vinegar can usually be substituted for fresh lemon juice in recipes and obtain a pleasing effect although it lacks the vitamin C.
- Saucing roast lamb – pouring cider vinegar over the meat when roasting lamb, especially when combined with honey or when sliced onions have been added to the roasting pan, produces a sauce.
- Sweetened vinegar is used in the dish of pork knuckles and ginger stew, which is made among Chinese people of Cantonese backgrounds to celebrate the arrival of a new child.^[21]
- Sushi rice – Japanese use rice vinegar as an essential ingredient for sushi rice.
- Commonly put into water-pepper sauce, for general palate preference.
- Red vinegar – Sometimes used in Chinese soups.
- Flavoring – used in the Southern U.S. to flavor collard greens, green beans, black-eyed peas, or cabbage to taste.
- Commonly put into mint sauce, for general palate preference.
- Vinegar – especially the coconut, cane, or palm variety – is one of the principal ingredients of Philippine cuisine.
- White vinegar can be used as flavoring in ham and beans.
- It is used in the making of escabeche fish.

Beverage

Several beverages are made using vinegar, for instance Posca. The ancient Greek oxymel is a drink made from vinegar and honey, and sekanjabin is a traditional Persian drink similar to oxymel. Other preparations range from simply mixing sugar water or honey water with small amounts of fruity vinegar, to making syrup by laying fruit or mint in vinegar essence for several days, then sieving off solid parts, and adding considerable amounts of sugar. Some prefer to also boil the result as a final step. These recipes have lost much of their popularity with the rise of carbonated beverages, such as soft drinks.

Folk medicine and research

Many traditional remedies and treatments have been ascribed to vinegar over millennia and in many different cultures, although no medical uses are verified in controlled clinical trials. Some folk medicine uses have side effects that represent health risks.^[22]

Diet and diabetes

Small amounts of vinegar (approximately 25 g of domestic vinegar) added to food, or taken along with a meal, were proposed in preliminary research to reduce the glycemic index of carbohydrate food for people with and without diabetes.^{[23][24]}

Some preliminary research indicates that taking vinegar with food increases satiety and reduces the amount of food consumed.^{[25][26]}

Antimicrobial

The growth of several common foodborne pathogens sensitive to acidity is inhibited by common vinegar (5% acetic acid).^{[27][28]}

Among these are:

- *Clostridium botulinum* (which can survive anaerobic conditions and high temperatures and is thus not always affected by sterilization)
- *Salmonella*
- *Listeria*
- *Staphylococcus*
- *Escherichia coli* O157:H7 (which can tolerate an acidic environment to some extent)

The active ingredient in vinegar, acetic acid, can effectively kill mycobacteria, as tested against drug-resistant tuberculosis bacteria as well as other mycobacteria.^[28]

Polyphenols

The phenolic composition analysis of vinegar shows the presence of numerous flavonoids, phenolic acids and aldehydes.^{[29][30]}

Other uses

Applying vinegar to common jellyfish stings deactivates the nematocysts, although not as effectively as hot water.^[31] This does not apply to the Portuguese man o' war, which, although generally considered to be a jellyfish, is not; vinegar applied to Portuguese man o' war stings can cause their nematocysts to discharge venom, making the pain worse.^[32]

Vinegar is not effective against lice.^[33] Combined with 60% salicylic acid, it is significantly more effective than placebo for the treatment of warts.^[34]

Potential hazards

Like other acids, the acetic acid in vinegar attacks the enamel of the teeth and will cause decay and sensitivity in the teeth. As with other acids, some organizations recommend minimizing consumption, minimizing time in the mouth, not swirling it in the mouth, and counteracting the effects by using a baking soda mouth rinse.^[35]

Esophageal injury by apple cider vinegar tablets has been reported, and, because vinegar products sold for medicinal purposes are neither regulated nor standardized, they vary widely in content, pH, and other respects.^[36] Long-term heavy vinegar ingestion has one recorded case of possibly causing hypokalemia, hyperreninemia, and osteoporosis.^[37]

Cleaning

White vinegar is often used as a household cleaning agent.^[38] Because it is acidic, it can dissolve mineral deposits from glass, coffee makers, and other smooth surfaces.^[39] For most uses, dilution with water is recommended for safety and to avoid damaging the surfaces being cleaned.

Vinegar is an excellent solvent for cleaning epoxy resin and hardener, even after the epoxy has begun to harden. Malt vinegar sprinkled onto crumpled newspaper is a traditional, and still-popular, method of cleaning grease-smearing windows and mirrors in the United Kingdom.^[40] Vinegar can be used for polishing brass or bronze. Vinegar is widely known as an effective cleaner of stainless steel and glass.

Vinegar has been reputed to have strong antibacterial properties. One test by Good Housekeeping's microbiologist found that 5% vinegar is 90% effective against mold and 99.9% effective against bacteria,^[41] though another study showed that vinegar is less effective than Clorox and Lysol against poliovirus.^[42] In modern times experts have advised against using vinegar as a household disinfectant against human pathogens, as it is less effective than chemical disinfectants.^[22]

Vinegar is ideal for washing produce because it breaks down the wax coating and kills bacteria and mold. The editors of Cook's Illustrated found vinegar to be the most effective and safest way to wash fruits and vegetables, beating antibacterial soap, water and just a scrub brush in removing bacteria.^[43]

Vinegar has been marketed as an environmentally-friendly solution for many household cleaning problems. For example, vinegar has been cited recently as an eco-friendly urine cleaner for pets.^[44]

Vinegar is effective in removing clogs from drains, polishing silver, copper and brass as well as ungluing sticker-type price tags.^[45] Vinegar is one of the best ways to restore colour to upholstery like curtains and carpet.^[43]

Vinegar also can help remove wallpaper. If the paper is coated with a mixture of vinegar and boiling water, it breaks down the glue for easy removal.^[43]

Agricultural and horticultural

20% acetic acid vinegar can be used as a herbicide.^[46] Acetic acid is not absorbed into root systems; the vinegar will kill top growth, but perennial plants may reshoot.^[47]

Miscellaneous

Most commercial vinegar solutions available to consumers for household use do not exceed 5%. Solutions above 10% require careful handling, as they are corrosive and damaging to the skin.^[48]

When a bottle of vinegar is opened, mother of vinegar may develop. It is considered harmless and can be removed by filtering.^[49]

Vinegar eels (*Turbatrix aceti*), a form of nematode, may occur in some forms of vinegar unless the vinegar is kept covered. These feed on the mother of vinegar and can occur in naturally fermenting vinegar.^[50]

Some countries prohibit the selling of vinegar over a certain percentage acidity. As an example, the government of Canada limits the acetic acid of vinegars to between 4.1% and 12.3%.^[51]

According to legend, in France during the Black Plague, four thieves were able to rob houses of plague victims without being infected themselves. When finally caught, the judge offered to grant the men their freedom, on the condition that they revealed how they managed to stay healthy. They claimed that a medicine woman sold them a potion made of garlic soaked in soured red wine (vinegar). Variants of the recipe, called Four Thieves

Vinegar, have been passed down for hundreds of years and are a staple of New Orleans hoodoo practices. [52][53]

A solution of vinegar can be used for water slide decal application as used on scale models and musical instruments, among other things. One part white distilled vinegar (5% acidity) diluted with two parts of distilled or filtered water creates a suitable solution for the application of water-slide decals to hard surfaces. The solution is very similar to the commercial products, often described as "decal softener", sold by hobby shops. The slight acidity of the solution softens the decal and enhances its flexibility, permitting the decal to cling to contours more efficiently.

When baking soda and vinegar are combined, the bicarbonate ion of the baking soda reacts to form carbonic acid, which decomposes into carbon dioxide and water.

See also

- Food additive
- List of condiments
- Vinegar tasters

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