

EVALUATING BEER

Acetaldehyde

Taste and aroma of green apples, grass, green leaves, latex paint. Can be green beer, beer prematurely removed from the yeast, bacterial spoilage, high fermentation temperatures, or aeration after fermentation begins, the yeast strain.

Acetic

Vinegar Character that is driven off by a vigorous boil.

Alcoholic

This flavor may be detected as a spicy, vinous character in the aroma and taste and is often accompanied by a warm or prickly mouth feel. The simplest and most prevalent alcohol in beer is ethanol, which is produced by the fermentation of glucose and other reducing sugars. Higher, or fusel alcohols are usually present at sub-threshold concentrations; but elevated levels are associated with under pitching, low levels of dissolved oxygen prior to pitching or low levels of free available nitrogen (FAN). These deficiencies force the yeast to metabolize fatty acids in the trub as a source of oxygen and carbon, producing a greater fraction of long chain alcohols. High gravity worts and high fermentation temperatures also tend to increase the concentration of these higher alcohols through increased yeast activity. Alcoholic characteristics are desired in strong ales and lagers as long as they are not coupled with the solvent notes associated with elevated ester or fusel alcohol levels.

Astringency

This flavor is a mouth puckering sensation that is comparable to chewing on grape skins or grape seeds. Grainy or Husky attributes can be produced by the extraction of tannins from grain husks due to over crushing, over sparging, or sparging with alkaline or water to hot. Astringency may also be produced by polyphenols that result from spoilage by acetobacter or wild yeast. Another possible source is oxidation, in which case the responsible compounds are polyphenols and aldehydes. Finally, spices such as coriander, orange peel and cinnamon also contribute astringent flavors, but these tend to mellow with age. Note that over-attenuation and low dextrin levels can increase the perception of astringency.

Autolysis

Yeasty, Vitamin flavor from over pitching, sits on yeast too long, or too much nutrient. Meaty or Rubber

Bitterness

Bitterness, or rather excessive bitterness, is perceived as a harsh dry taste on the back of the tongue. It is usually due to over-hopping, especially when high alpha hops are used. Roasted malts and high concentrations of magnesium and sulfate ions also contribute to the overall bitterness. Bitter compounds may also be produced by oxidation or contamination by wild yeast, in which case there are usually other off-flavors. High levels of hop bitterness are appropriate in IPA's and Barleywines, while bitterness due to roasted barley/malt is appropriate in robust porters and dry stouts.

Body

The body of a beer is characterized as the fullness of the flavor and mouth feel, and descriptors range from watery or characterless to satiating or thick. Body is technically separate from mouth feel, which encompasses physical sensations such as astringency, alcoholic warmth and carbonation, but the combination determines how the beer stimulates the palate. The levels of dextrin and medium-length proteins determine the body. Low saccharification temperatures cause lack of dextrin, excessive use of adjuncts or by highly attenuative yeast strains. Excessively long protein rests; excessive fining or the addition of large amounts of fermentable sugars may cause a low protein level. Light body is appropriate in American light lagers and lambics, but not in malt accented styles such as barley wines and Doppelbocks.

Diacetyl

Artificial butter, butterscotch or coffee-like aroma and taste. At low levels, it may also produce slickness on the palate. Diacetyl is a fermentation by-product, which is normally absorbed by the yeast and reduced to more innocuous diols. High levels can result from prematurely separating the beer from the yeast or by exposure to oxygen during the fermentation. Under aeration, under pitching, a fast chill down. Low FAN levels or mutation may also inhibit the ability of yeast to reduce diacetyl. Note that high fermentation temperatures promote both the formation and elimination of diacetyl, but the latter is more effective. For that reason, lager breweries often employ a diacetyl rest, which involves holding the beer in the 50-55 F range for a few days after racking to the conditioning tank. Lactic acid bacteria, notably *Pediococcus damnosus*, also produce Diacetyl. Low levels of diacetyl are permissible in nearly all ales, particularly those brewed in Scotland, and even some lagers, including Czech pilsners and Vienna-style beers.

DMS

Dimethyl-sulfide produces the aroma and taste of cooked vegetable, notably corn, canned corn, celery, cabbage or parsnips. In extreme cases it may even be reminiscent of shellfish or water in which shrimp has been boiled. Evaporates during an open, rolling boil. A closed boil or slow cooling of the wort (created between 160-200) may therefore lead to abnormally high levels. Can also be from Pilsner Malt and low sparge temperatures. Some DMS is also scrubbed out during a vigorous fermentation, which is why Lagers and cold-conditioned ales may have slightly higher levels than warm-fermented ales. Wild yeast or *Zymomonas bacteria* may produce high enough levels of DMS to make the beer undrinkable. Low levels of DMS are appropriate in most lagers, particularly American light lagers and pre-prohibition pilsners, but are not desirable in any ale style.

Estery/Fruity

This is an aroma and taste that recalls bananas, strawberries, pears, apples, plums, papaya and/or other fruits. The responsible compounds are esters, which are formed from the combination of an alcohol and an organic acid. High ester levels are a product of the yeast strain, fermentation temperature, high gravity worts and the metabolism of fatty acids in the trub. These flavors are desirable in most ale, particularly Belgian and British styles, and the signature banana notes in Bavarian wheat beers are primary due to the ester isoamyl acetate. Note that esters often have solvent notes at very high concentrations.

Ethyl Acetate

A perception of finger nail polish, paint thinner, solvent. Comes from high fermentation temperature, excessive trub. Maturation will help.

Grassy

This is the flavor and aroma of freshly cut grass or green leaves. Responsible compounds include the aldehydes hexanal and heptanal, which are produced by the oxidation of alcohols in the finished beer or the deterioration of improperly stored malt or hops. Some English and American hop varieties produce grassy notes if used in large quantities, but this flavor should not be a significant part of the profile.

Head Retention

Good head retention is measured in terms of the time required for the head to collapse to half of its initial height. This should be at least a minute in well-brewed and conditioned beers. The beading should also be uniform and tight, leaving lace on the glass as the beer is consumed. Good head retention is promoted by several factors, including isohumulones, high original gravity, alcohol content, dextrin and the levels of high and medium molecular weight proteins. Adequate carbonation is also important. Most of these variables are style-dependent, but the brewer can increase the protein content by adjusting the length and temperature of the protein rest and using adjuncts such as flaked wheat and barley. Fatty acids carried over from the trub and unclean glassware are both detrimental to head stability, since they decrease the surface tension of the foam, causing the bubbles to collapse.

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Husky/Grainy

This may be perceived in both the aroma and the taste and is reminiscent of the flavor of spent grains. Possible causes include over crushing, over sparging or sparging with hot or alkaline water. Long mashes may also leach these flavors from the grain husks. Low levels are acceptable in some lagers, but are not appropriate in any ale.

Lightstruck/Skunky

This aroma and taste is due to the presence of the same mercaptans that are found in the scent glands of skunks. These compounds are formed when ultraviolet light cleaves an isohumulone molecule, and the resulting radical combines with a sulfur compound. Beer stored in clear or green glass bottles is more susceptible to this reaction, which is why brown glass offers more protection. Lightstruck flavors are not desirable in any style, but many European imports possess this quality. Cheesy aromas can be from old hops. Note that Miller Brewing is able to use clear glass bottles because they use a chemically modified form of isohumulone that does not interact with light.

Musty

This is a stale aroma and taste associated with the oxidation of malt compounds in the melanoidin family. This oxidation can occur in the mash or boil via hot side aeration or by exposure to air when racking or bottling. The responsible compounds may be latter transformed to their reduced state by oxidizing alcohols into aldehydes. Musty flavors are generally not desirable, but may be found in some cellared beer styles such as Biere de Garde.

Oxidation/Paper/Cardboard

These are perceived in both the aroma and flavor and are primarily due to the aldehyde, 2-trans-nonenal. This compound has an extremely low flavor threshold and is produced by the Oxidation of higher alcohols. Minimizing splashing of the hot wort or of the fermented beer while racking or bottling may reduce the threat of oxidation. Paper, cardboard, stale, and musty can occur from air transfer into beer while filtering, bottling, kegging, and storage at high temperatures, and excessive aging; This flavor is never appropriate and is rare in homebrew due to the reducing power of yeast, but it is a common flaw in many old or abused commercial beers.

Phenolic

This is an aroma and taste often compared to Band-aids (tm), medicine chest or disinfectant. Chlorophenols are particularly offensive members of this family with bleach-like flavors in addition to the ones listed above. Bacteria or wild yeast, both of which indicate a sanitation problem, generally produces high levels of phenols. Phenols may also be extracted from grain husks by over crushing, over sparging or sparging with hot or alkaline water. Chlorinated water or sanitizer residues are possible sources of chlorophenols. Phenolic flavors are generally never desirable, the exception being the clove-like, vanilla like or slightly smoky flavors and aromas in Bavarian wheat beers and some Belgian ale.

Sherry-like

This is the aroma and taste of dry sherry and is often accompanied by hazelnut or almond notes. The responsible compounds are oxidized members of the melanoidin family. This flavor is one of the few positive flavors attributed to oxidation and adds complexity to Barley wines, old ales and Scotch ales. Sherry-like flavors are considered a defect in most other styles, particularly low-gravity ales.

Solvent-like

This describes an aroma and taste similar to turpentine or acetone that is often accompanied by a burning sensation in the back of the mouth. It is due to high concentrations of ethyl acetate and other esters, as well as fusel alcohols. Possible sources include under pitching and fermenting on the trub, especially at elevated temperatures. Contamination by wild yeast may produce elevated levels of both esters and fusel alcohols. Solvent-like notes are generally undesirable, but perceptible levels may be encountered in old ales such as Theakstons Old Peculier.

Sour/Acidic

This is usually perceived as a taste on the, sides of the tongue, towards the rear of the mouth. The two most common acids responsible for this flavor are lactic and acetic which both have related esters that may be perceived in the aroma. Gram-positive bacteria such as Lactobacillus and Pediococcus, which are present in dust and saliva, produce lactic acid. Acetic acid may be produced by several contaminants, including *Acetobacter*, *Zymomonas*, and yeast in the *Kloeckera* and *Brettanomyces* families. High levels of sour and acidic flavors generally indicate a sanitation problem, but they are an important part of the profile of the lambic, oud bruin and Berliner Weiss styles, and to a lesser extent, Belgian white beers.

Sulfury/Yeasty

These flavors, not to be confused with DMS, have the aroma and taste of rotten eggs, shrimp or rubber. The compounds responsible for these flavors originate from sulfur containing amino acids such as cysteine and methionine. Possible sources include yeast autolysis, bacterial spoilage and water contamination. These flavors can be quite putrid and are not desirable in any style. In the same family are sulfitic flavors, which recall the aroma of a struck match. Use of sulfites, a young beer, and some lager yeast will have some sulfur character. They are usually due to the overuse of antioxidants, and while rare in beer, are quite common in wine and cider.

Sweet

Sweetness is a taste perceived primarily at the tip of the tongue and is due to the presence of reducing sugars. High levels of residual sugars can result from a flocculant or low-attenuating yeast or poor yeast health linked to low FAN levels or low levels of dissolved oxygen prior to pitching. High gravity worts, high dextrin content and the addition of lactose also play a role in determining the sweetness of the finished beer. The appropriate level is style-dependent, with high levels desirable in most strong ales and lagers, and low level in American light lagers and lambics.

Worty

Tastes like malt extract, can be from incomplete fermentation, low boil, bad malt. A vigorous boil and a complete fermentation will eliminate this problem.