Reference 1: Glossary of Terms

Acid – A broad class of compounds with specific chemical properties. While some acids can corrode metals and damage organisms and skin, others are common in food, such as citric acid (found in citrus fruits) and acetic acid (vinegar). When a compound contains the word "acid," it simply means the compound possesses the chemical traits necessary to be classified as an acid.

Alpha acids – A group of compounds found in the lupulin glands of hops and commonly used to impart bitterness in beer. Three compounds called humulone, cohumulone, and adhumulone account for the majority of the alpha acids found in hops. In their natural form, these compounds dissolve poorly in water and wort. During brewing, boiling of the hops transforms or isomerizes native alpha acids into a form that is both more bitter and more soluble in wort and beer. Alpha acids typically account for 2–20% of the dry weight of hops.

Amino acids – A group of 21 nitrogen-containing compounds that link together to form proteins. While all amino acids share a common basic structure or backbone, the "side group" for each amino acid varies from a simple single atom to a complex ring structure. Some side groups contain sulfur or an additional nitrogen atom. The variation in these amino acid side groups allows proteins to take many shapes and to perform many different functions in biochemistry. Examples of amino acids include lysine and methionine.

Amylase – A type of enzyme found in barley and malt which breaks the bonds between individual sugars in a starch molecule. Brewing calls upon two specific types: alpha amylase and beta amylase. Alpha amylase forms in barley during malting and breaks bonds between sugars anywhere along the entire length of a starch molecule. Beta amylase occurs in raw barley and survives in malt, but can only break bonds between sugars found at the end of the starch molecule. The action of beta amylase produces the sugar maltose—the most common sugar in wort.

Atom – The smallest unit of any element: an atom of carbon or an atom of hydrogen is the smallest amount of that element that exists. Atoms combine to form molecules; two hydrogen atoms and one oxygen atom combine to form one molecule of water. The number of atoms in a molecule varies widely. The simplest molecules contain just two atoms; the most complex molecules have thousands of atoms.

Beta acids – A group of secondary bittering compounds found in hops. Also called lupulones.

Carbohydrates – A broad class of biochemical compounds composed entirely of three elements: carbon, hydrogen, and oxygen. Carbohydrates include big molecules, such as starch, and smaller ones all the way down to individual sugars, such as maltose and glucose. The name "carbohydrate" comes from the fixed ratio between the atoms where each carbon (C) is accompanied by one molecule of water (H_2O).

Dextrin (limit dextrin) – A carbohydrate which brewer's yeast cannot ferment derived from starch. The breakdown of starch into fermentable sugars during mashing generally results in the formation of some dextrins. Dextrins form because amylase enzymes cannot break all of the bonds between sugars found in starch. Additionally, brewers can control the level of dextrin formation to a degree during mashing. While dextrins have no flavor, they survive into finished beer where they contribute to body and mouthfeel.

Element – The simplest chemical substances such as carbon, hydrogen, and oxygen. Elements cannot be broken down using chemical methods.

Enzyme – A special type of protein that functions as a catalyst in a biochemical system. Each enzyme promotes one very specific chemical reaction. (See also: *beta amylase*.) Enzymes play an essential role in plants and organisms, and even a simple single-celled organism like brewer's yeast has thousands of different enzymes.

Essential oils – A diverse collection of hop oils and their oxidized products which can impart both flavor and aroma in beer. The four most common essential hop oils include: humulene, myrcene, caryophylline, and farnescene. Essential oils evaporate easily and change structure and character when heated. Thus brewers boil flavor and aroma hops for a shorter period than they do bittering hops. Oils may also be dissolved in beer slowly, through a process known as dry hopping—the addition of hops to fermented beer for a period of several days or weeks.

Extract – The sum total of all compounds derived from malt and dissolved into the liquid which comprises wort or beer. Typically, the chief component of extract in wort (prior to fermentation) is sugars. Extract also contains unfermentable carbohydrates known as dextrins. These are the chief component of extract in finished beer.

Gravity – A measure of the extract dissolved in wort or beer. See *specific gravity* and *Plato.*

Humulone (adhumulone, cohumulone) – See *alpha acids.*

Iso-alpha acids – The isomerized form of alpha acids, which contribute bitterness to beer. See *alpha acids*.

Isohumulone – The isomerized form of the alpha acid humulone. See *alpha acids*.

Isomerize – In chemistry, isomerization occurs when a compound changes its structure without any change to the overall number and type of atoms it contains.

Maillard reaction (pronounced: my-YAR) – An important source of color and flavor in malt, beer, and other foods. The Maillard reaction begins when amino acids and sugars combine under moderate heat. This initiates a long and complex series of reactions that form hundreds of different color and flavor compounds. Since malt contains both amino acids and sugars, Maillard reaction products formed during malting contribute significantly to beer flavor and color.

Maltose – A sugar that consists of two molecules of glucose linked together.

Melanoidin – The color compounds formed by Maillard reactions are called melanoidins. Many incorrectly attribute flavor to melanoidins. While color and flavor compounds both result from Maillard reactions, the flavors produced belong to a different class of compounds. Melanoidins contribute color but not flavor.

Molecule – A molecule is made up of two or more atoms connected by chemical bonds in a specific ratio. For instance, a water molecule consists of two hydrogen atoms and one oxygen atom. A molecule of the sugar glucose consists of six carbon, six oxygen, and twelve hydrogen atoms.

Plato – A measure of gravity, or the amount of extract dissolved in wort or beer. Expressed in degrees, the number given by a Plato reading represents the percent, by weight, of extract in the solution being measured. A typical Plato reading has the form 12.3 °P.

Polyphenols – A large category of complex molecules that play roles in plant coloration, structure, and protection among others. Well known for their affinity for binding with proteins. Some polyphenols, such as tannins, impart flavor in wine, tea, coffee, and, to a degree, in beer.

Protein – A protein consists of hundreds to thousands of amino acids organized into one or more chains. Proteins serve many functions in cells ranging from structural to catalytic. Enzymes are an important category of proteins.

Specific gravity – The specific gravity of beer is one common measure of gravity, or the extract dissolved in wort or beer. Specific gravity values represent the weight of the liquid being measured, divided by an equivalent measure of pure water. In wort and beer, specific gravity generally takes the form 1.XXX, for example 1.048.

Starch – A large carbohydrate molecule that plants use to store energy reserves. Starch consists of long chains and bush-like branches of the simple sugar glucose linked together. The breakdown of starch during mashing primarily results in the formation of *maltose* and *dextrins*.

Sugar – A small carbohydrate, which serves as the building block for longer molecules such as starch. Glucose is a sugar, which has the chemical formula of $C_6H_{12}O_6$.

Tannin – A specific type of polyphenol noted for the flavor it contributes to wine, tea, and sometimes beer. Tannins contribute an astringent flavor common in red wines and strong tea. When present, tannins contribute to a "drying" mouthfeel, and at high levels can produce astringent sensations. The first taste of a beverage with significant tannin content may be described as giving a mouth coating impression.