

GLOSSARY

α -Acids: Part of the soft resins of hops (soluble in liquid CO₂, ethanol and organic solvents such as methylene chloride and hexane), the pre-cursors of the bitter compounds in beer.

Abrasion: The process of selectively damaging the distal end of the barley grain to stimulate aleurone activity and “two way” modification.

Acidity: Results from the brewing materials used and yeast metabolism. Usually varies from 0.10 to 0.17 (as lactic acid, g / 100 g).

Acid washing: Cleansing the yeast with acid to destroy microbial contaminants, without killing the yeast.

β -Acids: Part of the soft resins of hops. General term for lupulones (lupulone, colupulone and adlupulone).

Acrospire: The embryonic shoot which emerges from the protective leaf sheath (the coleoptile).

Actinomycetes: Refers to the species of fungi which form mycelium.

Adjunct: Any carbohydrate source other than malt that contributes fermentable sugars to the wort (usually less expensive than barley malt).

Adventitious roots: Secondary roots developed at the crown or base of the barley plant.

Aerobic: In the presence of oxygen.

Aging: See maturation.

Air rest: A period employed during steeping of barley in which the water is drained from the grain bed to replenish oxygen levels available to the grain.

Albumin: A group of water soluble proteins present in barley, other plants and animals.

Aleurone: Respiring cellular layer, 3 cells thick, separating the endosperm from the pericarp and testa. Responsible for the synthesis and release of α -amylase and other hydrolytic, endosperm degrading enzymes.

Amino acid: The monomer units of protein all of which have an amino-terminal end (-NH₂) and a carboxyl-terminal end (-COOH) to the molecule. These are the ‘building blocks’ that make up proteins. There are 20 different amino acids used in protein synthesis.

Amylases: Starch degrading enzymes.

Amylose: A linear polymer of glucose, accounting for approximately 25% of starch.

Amylopectin: A branched polymer of glucose accounting for the remaining 75% of starch make up.

Anabolism: A series of biochemical reactions in which cell constituents are synthesised from simple precursors.

Anaerobic: Lacking oxygen; anaerobic organisms grow in the absence of oxygen.

Aneuploid: A term to describe a genetic state; cells with missing, extra or parts of chromosomes.

Anther: Slender extension of the stamen within which pollen grains form.

Anthesis: Flowering.

Apparent Extract (AE): The measure of extract in the beer and is expressed in degrees Plato (°P) or specific gravity. No allowance is made for the effect of alcohol on the specific gravity.

Ascospore: A spore typically uninucleate and haploid, formed within an ascus.

Ascus: A sac containing ascospores.

ATP: Adenine triphosphate, a biological energy carrier molecule.

Attenuation: The process by which the specific gravity of the wort decreases during fermentation.

Attenuation Limit: The lowest specific gravity which can be reached with a particular yeast strain in a specific wort.

Autolysis: The breakdown of a cell by its own enzymes.

Auxiliary finings: Agents used in association with isinglass to settle and promote the removal of insoluble particulates from green beer during maturation.

Awn: Stiff, bristle like extension of the lemma. Appears as a beard like projection on the barley corn.

Beer Stability: A term that refers to the overall stability of beer in the trade. There are five categories of beer stability: flavour, chill or physical, foam, light and biological or microbiological.

Beer stone: A precipitate of calcium oxalate.

Biological stability: The susceptibility of a beer to microbial infection.

Bitterness: A measurement of the amount of iso- α -acids that have been extracted from hops. The α -acids are isomerized to the soluble bitter substances during the wort kettle (copper) boil. For determination of the bitterness level, the acids are extracted with iso-octane and the absorbency at 275 nm determined. Bitterness Unit (B.U.) = $A_{275} \times 50$.

Bodyfeed: Filter aid added to the filter throughout the filter run in proportion to the beer flow.

Bottom fermentation: Fermentation in which the yeast flocculates, sediments and collects at the bottom of the fermentation vessel. Typically, Lager strains (*Saccharomyces carlsbergensis*).

Bracteoles: The leaves of a hop cone.

Brewhouse: The part of a brewery in which the grist material is prepared and converted into wort.

Brewster: A female brewer.

Bright beer: Beer that has been clarified, post-filtration.

Calandria: Internal or external heat exchanger specifically used for heating the wort in the brewhouse.

Calculated original extract: A calculation to determine the residual extract in beer as a percentage of the wort extract from which the beer was fermented. The calculation is based on the fact that theoretically 2.0665 g of extract produces 1.0 g of alcohol.

Carboxypeptidase: A hydrolysing enzyme of barley that degrades proteins by cleaving single amino acids.

Carrageenan: κ -carrageenan, the active component in copper finings, used to precipitate and remove proteins and polyphenols from the wort as trub during wort boiling.

Carbohydrate haze: A haze produced by particles of partly degraded starch polymers, which is registered by analytical equipment but is not perceptible to the human eye. Sometimes called a pseudo-haze.

Carbon Dioxide: One of the two major by-products of wort fermentation (the other being ethanol). The level of carbonation of a particular beer is characteristic.

Casting: The transfer of a liquid between vessels.

Catabolism: Metabolic process of breaking down complex molecules to simple ones and releasing energy.

Cereal Cooker: Vessel in which the unmalted cereals [for example: wheat, maize (corn) and rice] must be cooked prior to addition to the malt in the mash tun. This is to ensure gelatinisation of the starch.

Chill Haze: Haze (proteins + polyphenols) which can form when beer is chilled.

Chit: Term used to describe the coleorhiza (root sheath). It has the appearance of a white dot as it pushes through the husk at the onset of germination. Chitting signals the end of steeping during malting.

Chlorophyll: Green pigment in all algae and higher plants responsible for the capture of light “energy” during photosynthesis.

CIP (Cleaning In Place): The integrated, automated, cleaning system (using caustic or acid) employed to sanitise plant hardware.

Cling: See lacing.

Coalescence: The action of gas bubbles as they merge generating larger bubbles.

Cold break: Insoluble material, similar in composition to trub, that drops out of wort on chilling.

Coleoptile: The protective sheath from which the embryonic shoots emerge.

Coleorhiza: Protective sheath of the embryonic rootlets.

Colloidal instability: The inclination of a beer to develop or throw a haze during storage.

Colony: A visible population of identical cells arising through multiplication of a single cell on solid media. Numbers are often expressed as colony forming units (CFU).

Colour: Beer colour is defined as ten times the optical density of the beer measured at 430 nm.

Complementary genes: Two genes which must be present for the manifestation of a characteristic.

Conditioning: See maturation.

Continuous fermentation: A process whereby wort is fermented to green beer in a few hours by passage through a column containing immobilised yeast.

Copper: The vessel used for wort boiling.

Cropping: A term used for the collection of yeast at the end of fermentation.

Crown: Term given to the first node to develop during barley plant growth.

Culms: The desiccated rootlets of malt collected after kilning and sold as animal feed.

Cultivar: Variety of plant found only under cultivation.

Curing: The final high temperature stage of kilning during which malts characteristic colour and flavour form.

Cuticle: Superficial non-cellular layer, secreted by and covering the epidermis of plants.

Deoxynevelanol: A carcinogenic mycotoxin that can induce beer gushing.

Derepression: A term used to describe gene regulation.

Dextrins: Partial degradation products of starch consisting of several glucose units which the yeast cannot metabolise.

Diacetyl: A buttery or butterscotch like aroma compound which is produced and then reduced by yeast during fermentation. It can also be produced by bacteria during and after fermentation. Usually kept below 0.08 µg/ml.

Diastatic Power (DP): The determination of the combined amylolytic enzyme activities (α and β amylases) of malt.

Diatomaceous earth: See Kieselghur.

Dimethyl sulphide (DMS): Yeast metabolite that imparts a cooked cabbage flavour to beer, often a specific requirement in lagers. DMS is principally derived from precursors in malt but can be derived from bacterial infection.

Differentiation: The multiplication and division of cells which attain specialised functional biochemistry's and morphologies previously absent.

Diploid: A term used to describe a genetic state; a cell with two copies of each chromosome.

Dormancy: The control mechanism in barley preventing pre-germination.

Dropping: Following removal of yeast from the fermented wort, either with centrifuges or by flocculation, it is “dropped” into aging tanks.

Dry hopping: The action of adding hops to beer in cask after final processing.

dsDNA: Double stranded DNA.

Ear: Collective term for the cereal grains whilst attached to the tiller.

Electrophoresis: The separation of molecules using an electrical circuit, usually applied to a gel matrix. The gel matrix has a sieving effect which allows molecules to be separated on the basis of size, while the electric field separates molecules on the basis of charge.

Embryo: Young plant developed from an ovum. In seed plants it is located within the seed and comprises the origins of the roots and shoots.

Embryo sac: Large oval cell in the nucellus of the ovule, in which fertilisation of the egg cell and development of the embryo takes place. At maturity it resembles the entire female gametophyte.

Endosperm: Nutritive tissue surrounding and providing nutrients for the embryo in seed plants.

Enzymes: A biological catalyst (a protein) that assists a specific chemical reaction.

Essential oils: The aromatic constituents of hops.

Epidermis: Outer most layer of cells, comprising primary tissue one cell thick.

Ethyl alcohol: Another name for ethanol or alcohol.

Ethyl carbamate (Urethane): A carcinogenic compound found in most fermented foods and drinks. It is formed by the reaction of ethanol with a nitrogen containing compound in beer bottle cap liners, cyanogenic glycosides in fruit brandies, urea derived from arginine in wine and cyanide in whisky.

Eukaryote: A unicellular or multicellular organism with a complex organelle structure, typically characterised by internal organelles, multiple chromosomes and a nucleus.

Facultative aerobes: Organisms that use oxygen as a final electron donor if it is available, but grow fermentatively in its absence.

Fermentability: The extent to which a wort can be most utilised by the yeast to produce ethanol.

Fermentation: The conversion of wort sugars (for example glucose, maltose and maltotriose) by yeast to ethanol and CO₂ (one example) plus a plethora of other by-products, many of which contribute to the overall flavour of beer.

Flash pasteurisation: The passage of beer through a plate heat exchanger that rapidly heats the beer to a high temperature (>75°C) for less than a minute to kill any microbial contaminants.

Flavour stability: A measure of the extent to which a beer can defy detrimental flavour changes.

Flocculation: The agglomeration of yeast cells to form clumps of cells or flocs.

Finings: The materials used to clarify beer. They remove particulate matter through electrostatic interaction causing agglomeration into large particles that sediment out of the beer.

Foam: The head or froth of a beer.

Foam stability: The measurement of the rate of foam collapse of a beer sample.

Forcing test (1 week): Beer is stored at elevated temperatures for one week and will develop chill haze similar to that found in the same beer after prolonged storage at room temperature. F.T.U. = Formazin turbidity units.

Free Amino Nitrogen (FAN): The level of nitrogen present in wort or beer in the form of discrete amino acids.

Friability: The ability of malt to be readily reduced to a powder or flour.

Fusel alcohols: Higher alcohols, for example, butanol and iso-propanol.

Gelatinisation: The rupture and loosening of the internal crystalline structure of starch granules through heating to facilitate increased enzymatic degradation.

Gene: A segment of DNA that encodes a single polypeptide, protein or RNA molecule.

Genetic modification: The modification of an organism's genetic complement by inserting specific pieces of DNA from an exogenous source.

Genome: The entire collection of genetic information (contained in chromosomal DNA or RNA) in an organism.

Genotype: The specific genes that are present in an organism.

Germ: The embryo.

Germination: The manipulated growth of steeped barley (or wheat/sorghum) which is allowed to develop the hydrolytic endosperm enzymes which will modify (or convert) the endosperm starch, proteins and cell wall materials to useful extract.

Gibberellic acid: Gibberellic acid (GA₃) belongs to the gibberellin group of compounds. These are hormones which occur naturally in plants and fungi where they regulate a number of metabolic processes. During barley germination endogenous gibberellins, including GA₃, are responsible for stimulating enzyme synthesis and secretion from the aleurone layer.

Globulins: A class of proteins present in barley, other plants and animals, all heat-coagulable, soluble in dilute salt solution but not water.

β-Glucan: A polymer of glucose, forming the bulk of endosperm cell wall material in barley and responsible for generating viscous worts in the brewhouse.

β-Glucanase: An enzyme that hydrolyses and degrades β-glucan.

Glutelins: A class of insoluble proteins present in barley, other plants and animals; soluble in alkali.

Gluten: A wheat protein.

Glycoprotein: A protein with covalently linked sugar molecules.

Green beer: Fermented wort prior to any conditioning (ageing/ maturation), so-called because it can have the character of green apples due to the presence of elevated levels of acetaldehyde.

Green Malt: Germinated barley before it is dried (kilned).

Grist: The milled, cereal components of the recipe prior to mashing.

Gushing: The rapid uncontrolled loss of carbon dioxide and hence beer when packages are opened. The various causes of gushing are considered to be traces of unwanted materials in the beer including calcium oxalate crystals, metal ions, certain hop-derived compounds, hydrogen gas and compounds from moulds such as *Aspergillus* and *Fusarium*.

Haploid: A term used to describe a genetic state; a cell with a single copy of each chromosome.

Haze: Turbidity created by suspended solids.

Head retention: A measure of foam stability as the time taken for a beer's foam to collapse.

Headspace: The space remaining between a liquid's surface and the top of its container.

Heterologous: In relation to DNA, this term refers to DNA of a different source to the rest.

High Gravity Brewing: A process which employs wort at higher than normal concentration and hence requires dilution with deoxygenated water at a later stage in processing.

Higher alcohols: See Fusel alcohols.

Homogeneity: Uniformity – the property of a group whereby they are all of the same kind. For malt, the uniformity of modification among grains in a sample.

Hops: Bitter substances from the hop plant *Humulus lupulus*. These can be used as hop cones, hop pellets and powders or extracts. They can be added during the wort boil or later in the brewing process.

Hop back: Traditional vessel used to separate residual solids from boiled wort by passage through a bed of whole hop debris.

Hop cone: The flower of the female hop plant from which all of the brewing value of hops is obtained.

Hordein: A class of proteins present in barley, soluble in 60-75% ethanol, but not in salt solutions or water.

Hordenine: An amine found in malt acrospires probably the chief initial reactant with nitrogen oxides in a reaction chain leading to NDMA formation.

Hot break: The precipitate formed from insoluble materials on wort boiling.

Hot water extract: A measure of the extract potential of a grist composition obtained by carrying out a small scale mash in the laboratory and measuring the resulting wort's specific gravity.

Husk: The outermost layer of barley, comprising the desiccated cells of the lemma and palea.

Hydrophilic: Water loving.

Hydrophobic: Water hating.

Immobilised yeast: Yeast that has been attached to an insoluble carrier or support such as glass beads or carrageenan beads. Used to hold yeast masses within a defined area for continual processing of wort or beer.

Indehiscent: Fruits that do not spontaneously open and release their seeds.

Inflorescence: Collective term for a specific arrangement of flowers on an axis.

Invisible haze: A haze invisible to the human eye which is detected by a haze meter, see carbohydrate haze.

Integument: Outer cell layer(s) of ovule covering nucellus which later forms the testa.

Isinglass (finings): Solubilised collagen material obtained from the swim bladders of specific tropical and sub-tropical fish added to beer during maturation to aid beer clarification by promoting the sedimentation of insoluble colloids including yeast and haze particles.

Iso- α -acids: During wort boiling, the α -acids are converted to iso- α -acids. This conversion can also be effected by chemical means outside the brewhouse.

Isomerisation: The conversion of hop α -acids to iso- α -acids during wort boiling.

Joint: see node.

Jointing: Term used to describe the growth and elongation of the cereal stem.

Karyogamy: The fusion of nuclei.

Kettle: The vessel where the wort is boiled (also called a copper).

Kilning: The final step in malting. After the barley has germinated, the green malt is dried in a kiln under controlled conditions.

Kjeldahl method: A traditional chemical method for the determination of organic nitrogen compounds.

Krausening: Refers to a secondary fermentation. Wort is initially fermented for 5 to 7 days, then transferred to a krausen cellar where fresh wort is mixed with actively fermenting beer and fermented again, usually at lower temperatures, for prolonged periods.

Lacing: The phenomenon whereby beer foam sticks to the sides of glass's.

Late hopping: The addition of hops to the wort during the latter stages of boiling to impart characteristic hop aromas.

Lauter Tun: A vessel where the soluble components from the mash (mostly carbohydrates and some proteins, vitamins etc) are separated from the insoluble portion (grain husks or spent grains).

Lead conductance value (LCV): The measurement of hop bitter pre-cursors through their affinity to form lead salts.

Lectin: Proteins that bind to sugars or oligosaccharides.

Lemma: Lower member, of pair of bracts surrounding a grass flower, which it envelops along with its pair, (the palea) in forming the husk.

Lightstruck: A term used to define beer with a skunky flavour, produced through the photo-oxidation of the hop iso- α -acids when exposed to sunlight.

Limit dextrinase: Hydrolytic barley enzyme that degrades the amylopectin polymers within starch.

Lipoxygenase: A lipid oxidising enzyme.

Liquor: Industrial term for brewing grade water.

Liquid adjuncts: The major liquid adjuncts used in brewing are glucose/maltose syrups, cane sugar syrups and invert sugar syrups. Although differing in detail, the essential similarity is that they are all solutions of carbohydrates. They are usually added to the kettle during the wort boil.

Lodging: The action of the barley plant folding over under its own weight.

Lysis: Disruption or breaking open of a cell.

Maillard reaction: The production of coloured pigments (mellanoidins) through the reaction of amino acids and reducing sugars.

Malt: Dried modified (germinated) barley.

Malting: Malting involves steeping and germination of the barley producing amylases and proteinases, followed by kilning (drying) without significant inactivation of enzyme activity.

Mash: The mixture of grist and hot water.

Mashing: The process whereby milled malt, often with unmalted cereals, (adjuncts), and water are mixed and the enzymes formed during malting hydrolyse the starch and some proteins.

Mash Filter: An alternative apparatus to the lauter tun to effect filtration of the mash, capable of handling more finely ground grist.

Mash Tun: The vessel where the mashing process occurs. It can sometimes also be used for mash filtration.

Maturation: The holding stage post fermentation where beer is conditioned (i.e. removal of diacetyl and aldehydic flavour notes) prior to filtration and packaging.

Mealy: Term used to describe a barley endosperm that has a favorable, high proportion of water free spaces that facilitate rapid and thorough modification.

Meiosis: A process of cell division by which the chromosome number is reduced from diploid to haploid.

Mesophilic: An organism whose optimum growth temperature lies within a range generally accepted as 20 – 45°C.

Microaerophile: An aerobic organism that can grow only when oxygen tensions are reduced from that in the air.

Micropyle (Micropylar region): Canal formed by extension of integument(s) of ovule beyond apex of nucellus; recognisable in mature seeds as a minute pore in the seed coat (inc. husk, pericarp and testa) through which water can enter.

Mitosis: A normal process of cell division, in which the daughter cells have an identical set of chromosomes to the parent.

Modification: The hydrolytic degradation of starchy endosperm in the barley grain to generate fermentable extract during malting.

Mouthfeel: The tactile sensation of beer in the mouth (its texture).

Mutagen: A physical or chemical agent which causes a change in the cell's DNA.

Mutant: A gene that contains a mutation, or a protein expressed from a mutated gene.

Mycelium: A group or mass of discrete hyphae.

Mycotoxin: Poisonous materials produced by fungal agents.

NADH: A coenzyme that serves as an electron donor for many dehydrogenases.

Nitrosamines: Substances some at least of which have carcinogenic properties. Certain nitrosamines including n-nitroso-dimethylamine (N-NDMA) are formed during the kilning of malt, the primary reactants being an oxide of nitrogen and amines in the malt.

Node: Swollen section of barley stem caused by the growth of individual leaves.

Nucellus: Tissue surrounding and providing nutrition for the ovule.

Nucleation: The formation of gas bubbles in wort or beer

Obligate aerobes: Organisms that must use oxygen as their final electron acceptor.

Obligate anaerobes: Organisms unable to grow in the presence of oxygen.

Oligomer: Small polymers.

Organoleptic: An expression used to describe a food/beverage in terms of the senses, e.g. taste, aroma, mouthfeel, appearance.

Original Extract (O.E.): Percentage of sugars/carbohydrates in the wort (prior to yeast pitching and fermentation).

Osmotic pressure: The force that drives water to pass through a semi-permeable membrane from one solution to another more concentrated solution until the concentrations reach equilibrium.

Oxalic acid: An organic acid present in barley that reacts with calcium during brewing to form oxalate (beer stone).

Ovary: A hollow region containing ovule(s).

Ovule: Structure within the ovary that contains the fertilised egg from which the seed will develop.

Palea: Glume-like bract of grass spikelet on axis of individual flower. With the lemma envelops the seed and forms the grain husk.

Papain: A commercially prepared proteolytic enzyme derived from the papaya plant used to degrade protein-polyphenol hazes.

Pasteurisation: Heat treatment of a liquid to kill micro-organisms present.

Pasteurisation unit (P.U.): A measure of the amount of heat transferred to beer during pasteurisation. One P.U. is a one minute exposure to 60°C.

Pellicle: A film due to microbial growth on the surface of a liquid.

Pentosan: A structural polysaccharide of barley cell walls, in particular the endosperm cells.

Peptide: A chain of linked amino acids.

Peptide bond: The bond between two amino acids resulting from the combination of an amino group (-NH₂) attached to the central carbon atom of one amino acid and the carboxyl group (-COOH) of the central carbon atom of an adjacent amino acid. The bond formed (-NH-CO-) involves the elimination of water and is a condensation reaction.

Pericarp: The cellular layer separating the husk and testa in mature seeds formed from the wall of the ovary.

Perlite: Ground volcanic rock used as a filter aid, an alternative to kieselghur.

Permease: A system that transports substances against a concentration gradient across the plasma membrane into the cell.

Permanent Haze: Haze produced from the build up of chill haze that will not re-dissolve.

Phenotype: The physical characteristics of an organism determined by its expressed genes.

Pitching: The inoculation of brewery wort with yeast cells.

Plasmid: A small DNA molecule, separate from the chromosome(s), found in many bacteria and some yeasts.

Plato: Term utilised to describe wort, fermenting/ ageing wort and beer strength. Degree Plato (°P) is the weight of extract (sugar) equivalent to the weight of sucrose in a one hundred grain solution at 20°C (for example, 10% [w/w] sucrose = 10°P). Specific gravity is also related to °P (for example, 1040 ≡ 10°P, 1048 ≡ 12°P and 1080 ≡ 20°P).

Pollen: The male gametophyte of flowering plants.

Polymerase Chain Reaction (PCR): A repetitive process that copies a DNA template such that the number of copies increases exponentially.

Polypeptide: Molecule consisting of a single chain of many amino acid residues linked by peptide bonds. Each has an amino-terminal end (-NH₂) and a carboxyl-terminal end (-COOH) to the molecule.

Polyphenol: Organic compounds originating from the husk of barley and from hops that give beer an astringent flavour and interact with proteins to form haze particles.

Polyplloid: A term used to describe a genetic state, having three or more complete sets of chromosomes.

Purge: The forced removal of a substance e.g. O₂ can be removed from pipes and vessels by flushing them with CO₂ which pushes or purges the O₂ out.

Pre-germination: The uncontrolled germination of barley in the field, whilst the grains are still present on the ear.

Primary filtration: Sometimes (less often to-day), beer is filtered more than once. Under these circumstances, the beer is primary filtered, usually at the end of fermentation, to remove most of the yeast and some protein and polyphenols.

Primings: Sugar solutions added to kegged beers to provide additional sweetness and aid cask conditioning (including carbonation) in real ales.

Prokaryote: A unicellular organism that does not have a complex cellular structure; prokaryotes contain a single chromosome and do not possess a nucleus.

Propagation: The culturing of fresh yeast populations from a few cells to provide sufficient quantities to pitch each fermentation.

Propylene glycol alginate (PGA): A head stabiliser added to beer post filtration to guard against lipid damage.

Protease: A protein degrading enzyme.

Protein: Polymer of one or more polypeptide chains, comprised of amino acid monomer units joined by peptide bonds.

Proteolysis: The action of protein degradation.

PVPP (Polyvinyl polypyrrolidone): A polyacrylamide preparation that selectively removes polyphenols from beer therefore reducing its haze potential.

Rachis: The central axis of the cereal ear upon which cereal grains develop, an extension of the tiller.

Real extract: The actual amount of extract that remains in beer after fermentation with allowance made for the alcohol. The real extract is dependant on original gravity and the amount of original extract converted to alcohol and carbon dioxide.

Recombinant DNA: A DNA molecule that is comprised of multiple pieces of DNA from different sources, made in the laboratory.

Reduced iso extracts: Hop extracts that are light stable and protect against beer lightstrike (photo-oxidation).

Re-pitching: The removal of cropped yeast from one fermentation that is used to pitch another.

Residual gravity: The gravity of the wort at the end of fermentation.

Restriction enzyme: A class of enzyme (endonucleases), which cleaves DNA at a specific nucleotide sequence.

Reinheitsgebot: The Bavarian purity law dictating which raw materials can be used to brew.

Run Off: Removal of the clear wort from the mash (using a lauter tun, mash filter or mash tun).

Saladin box: A type of germination chamber used in malting.

Scutellum: Cotyledon cells separating the embryo and endosperm. Facilitates the transport of nutrients from the endosperm to the embryo.

Secondary filtration: If beer is filtered more than once, secondary filtration occurs after aging to remove residual yeast and chill haze.

Seminal roots: Primary roots that develop from the coleorhiza.

Set mash: The term given to a mash bed that is too thick for good enzyme distribution resulting in the halt of starch degradation.

Shelf life: The length of time a beer can be stored before its quality deteriorates to an extent that prevents consumption.

Shooting: See jointing

Silica hydrogels: Protein adsorbants used to reduce the haze potential of beer during maturation/filtration.

Skinning: Loss of husk.

Sparging: The action of spraying hot water onto the lauter tun grain bed to remove any residual fermentable extract at the end of mash/wort separation.

Specific gravity: The weight of the wort/beer in relation to the equivalent volume of water.

Spent grains: The insoluble fraction of the grains that remain behind after wort separation (lautering). Usually sold as animal feed either wet or dried.

Spikelet: Basic unit of grass inflorescences; a small group of grass flowers.

Stamen: Pollen producing organ of the barley flower.

Steely: Term used to describe a barley endosperm with few water free spaces that makes modification a slow process and produces poor quality malt.

Steeping: The first step in malting, involving the soaking of the barley in water to increase the grains moisture content.

Stigma: Terminal portion of the style.

Stuck fermentations: Fermentations that do not reach their attenuation limit.

Style: Slender column of tissue arising from the top of the ovary and through which the pollen tube grows.

Sweet Wort: The wort collected after filtration of the mash, usually prior to boiling and hop addition.

Tannic acid: Added to maturing beer to precipitate out proteins and reduce its haze potential.

Tannoids: Lower molecular weight polyphenols.

TCA cycle: Tricarboxylic acid cycle (Kreb's cycle), a biochemical pathway whereby energy is released in the form of ATP. It takes place in the mitochondria.

Testa: Cellular layer derived from the fused integuments of the ovary and nucellus, which fuses with the ovary wall to form the pericarp. Normally written as if one layer due to their close association e.g. the pericarp and testa.

Tetrazolium: A dye used to determine the viability of a barley grain.

Thermophile: An organism adapted to or surviving high temperatures, generally accepted as over 45°C.

Tiller: Term given to the cereal stem.

Top fermentation: A fermentation in which the yeast flocculates and collects at the beer surface near the top of the vessel. Typically, ale strains (*Saccharomyces cerevisiae*).

Total soluble nitrogen (TSN): A measure of the total dissolved protein in wort derived from the grist.

Trans-2-nonenal: An off-flavoured aldehyde produced from the oxidation of unsaturated fatty acids that give beer a papery or cardboard flavour.

Transamination: The transfer of amino groups, by a transaminase, from an amino acid to a α -keto acid, thus transforms a α -keto acid to an amino acid, e.g., conversion of α -ketoglutarate to glutamate.
(e.g. α -Amino acid + α -ketoglutarate \leftrightarrow α -keto acid + glutamate)

Transferases: A group of enzymes that catalyze the transfer of chemical groups from one substrate to another, e.g., hexokinase transfers a phosphate group from ATP to glucose.

Trub or Break: Heat sensitive proteins coagulate during wort boiling and form a precipitate known as trub or break. Trub may form with hot wort (hot break) and after cooling (cold break).

Turbidity: A measure of the 'cloudiness' of a liquid.

Vegetative: Not reproducing sexually.

Viability: A measure of an organism's capability to live.

Viable count: A measure of the number of living cells in a sample.

Vicinal diketones: Butterscotch flavored compounds, metabolic by-products of yeast fermentation e.g. diacetyl, & 2,3-pentanedione.

Vitality: The healthiness of an organism, typically yeast.

Volatiles: Although ethanol is the major excretion product produced by yeast during wort fermentation, this primary alcohol has little impact on the flavour of the final beer. Many other excretion products (volatiles) primarily determine the flavour of the beer. The composition and concentration of beer volatiles depends upon the raw materials, brewing procedures, fermentation etc. The following groups of substances are found in beer: alcohols, esters, carbonyls, organic acids, sulphur compounds, aminos, phenols and a number of miscellaneous compounds.

Vorlauf: The re-circulation of initial wort run-off from the lauter tun to ensure bright wort.

Wash: The distilling equivalent of wort.

Water activity a_w : The amount of free water or available water in a given substrate. Many organisms have an optimum a_w for growth.

Water sensitivity: The measure of a type of dormancy in barley where germination is suppressed due to the presence of excess water.

Whirlpool: A vessel used to allow the formation and collection of trub after wort boiling. The wort spirals round the vessel in a vortex fashion forcing the trub to settle into a cone on the vessel bottom.

Wild type: The natural (or unmutated) form of a gene.

Wild Yeast: Any yeast other than the pitching yeast is usually considered to be a wild yeast.

Wort: Unfermented aqueous extract of malted barley and other unmalted carbohydrate sources (unfermented beer).

Xerophile: Organisms that grow best at a low a_w .

Yeast: The eukaryotic micro-organism that converts wort into beer by producing alcohol and CO_2 together with a wide range of other metabolic by-products which contribute to beer flavour. The group of micro-organisms known as “yeast” is by traditional agreement, limited to fungi in which the unicellular form is predominant.

Zentner: A unit of hop mass (50 kg).