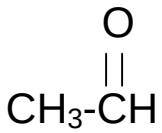
VEN 124 Glossary
Terms Used in Wine Chemistry, Biochemistry and Microbiology

Absorbance: Molecules absorb certain energies or wavelengths of light. This property can be exploited for the detection of specific molecules in solution. Spectrophotometers are designed to emit monochromatic (single wavelength) light and to detect the amount of light absorbed by a solution. This can be used to quantify the amount of agent present as the concentration of light absorbing species is directly correlated to the amount of light absorbed, assuming there are no other interfering compounds.

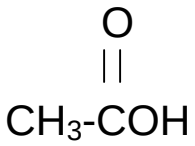
Absorption: The assimilation or incorporation of one substance by another; example: molecules absorb light; sponges absorb water

Accuracy: Agreement between a measured value and a "true" value can be compared to another method of known accuracy; can be determined by spiking a solution to be analyzed with an accurately measured amount of analyte

Acetaldehyde: Metabolite found in both prokaryotes and eukaryotes; produced by the decarboxylation of pyruvate

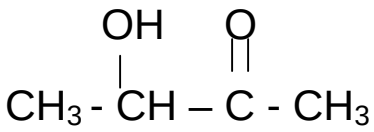


Acetic Acid/Acetate: Metabolite found in both prokaryotic and eukaryotic cells; produced from the oxidation of acetaldehyde; acetic acid refers to the protonated form, acetate to the unprotonated or salt form and can refer to an ester derived from acetic acid as in ethyl acetate



***Acetobacter*:** Bacterium; member of the acetic acid bacteria group; obligate aerobe that is a spoilage organism in wine production; will grow on the surface of wine exposed to oxygen producing large quantities of acetate and ethyl acetate; the agent used to make wine vinegar.

Acetoin: 3-hydroxy-2-butanone; metabolite produced by lactic acid bacteria from diacetyl or from α-acetolactate; generally below the threshold of detection in wine



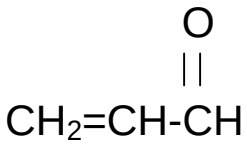
Acetyl-CoA: Co-enzyme A molecule carrying an acetyl group linked by a high energy bond; used in biosynthesis, especially of fatty acids; and in degradation of molecules, especially fatty acids

Acid: A chemical species capable of releasing or donating a proton; an electron pair acceptor (i.e. it donates the proton but keeps the electron pair)

Acidification: The process of increasing the acidity of a solution; in wine making accomplished by adding an acid species or by ion exchange of hydrogen ions of the resin for cations in the wine

Acidity: Generic term referring to the acid content of a solution; alternately possessing the property of donating a proton

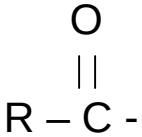
Acrolein: Metabolite produced by some lactic acid bacteria from glycerol; interacts with wine tannins to produce an intensely bitter character; an unsaturated carbonyl compound



Activated Carbon: Fining agent used to remove a wide range of compounds from wine, particularly phenolic compounds and anthocyanins; less effective against highly water soluble molecules

Active Dry Yeast: Term used to describe commercial preparations of yeast that have been dehydrated under conditions retaining viability.

Acyl: An organic compound containing a carbon atom with a double bond to an oxygen atom; usually derived from an organic acid by removal of the hydroxyl; found in esters, amides, anhydrides and acid chlorides



Acylate: To introduce an acyl group into, chemically using an acid chloride, biochemically using an acyl carrier protein

ADP: Adenosine diphosphate; an ester of adenosine that contains two phosphate groups; it is reversibly converted to ATP for the storing of energy by the addition of a high-energy phosphate group

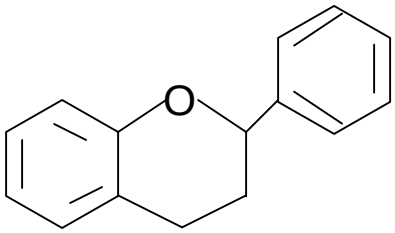
Adsorption: The adhesion of one substance to another due to electrostatic or ionic forces; interaction at a surface as opposed to absorption; example: filter matrices that adsorb particulates

Aeration: To bubble air through or otherwise expose to oxygen in the air

Aeration-Oxidation (AO): Procedure for the analysis of SO_2; use of air or an inert gas such as nitrogen to remove SO_2 from a solution to a hydrogen peroxide trap for analysis

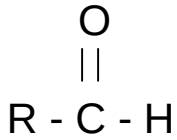
AFLP: Amplified Fragment Length Polymorphism; similar to RFLP except that PCR was used to synthesize a specific DNA fragment or fragments that are then digested with restriction endonucleases to detect differences in primary DNA sequence; used to determine the extent of relatedness of strains; alternately the divergence of strains due to genetic drift

Aglycone: General term for non-glycosidic or non-carbohydrate part of a glucocongujate; for example, the free flavonoid consisting of two aromatic rings linked via a pyran ring minus the glucose moiety is an aglycone

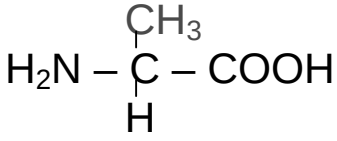


Alcohol: Organic compound containing a hydroxyl group: $R\text{-}OH$; sometimes used synonymously with ethanol $CH_3\text{-}CHOH$, but refers to a large range of compounds

Aldehyde: Organic compound of the general formula R-CHO with a double bond between the carbon and the oxygen, but see ketone



Alanine: A non-polar amino acid; 3 letter code: Ala; 1 letter code: A; mw: 89.09; pKa: 2.35; 9.69; pI: 6.02



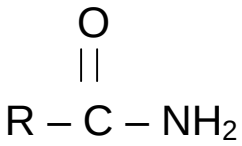
Albumen: Protein fining agent; derived from egg whites and primarily a mixture of two proteins: ovalbumin and conalbumin

Albumin: General class of water soluble proteins

Allosteric: Refers to a regulatory phenomenon controlling protein activity; specifically, refers to proteins in which the active site is impacted by small molecules binding to a secondary regulatory site called the allosteric site; the compounds are called allosteric effectors

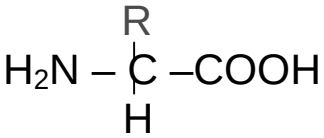
Amelioration: In wine production, the enhancement of the quality of a must or juice, such as changing acidity, pH or sugar level

Amide: Amine-containing derivative of a carboxylic acid



Amine: Nitrogen-containing organic compounds of the following general composition: RNH_2 (primary), R_2NH (secondary) or R_3N (tertiary); may show considerable basicity

Amino Acid: Amphoteric organic acid containing an amino group NH_2 in addition to a carboxyl group attached to the same carbon atom; especially any of the alpha-amino acids that are the chief components of proteins and are synthesized by living cells or obtained as essential components of the diet



Amino Acid	Three Letter Code	One Letter Code
Alanine	Ala	A
Arginine	Arg	R
Asparagine	Asn	N
Aspartic Acid	Asp	D
Cysteine	Cys	C
Glutamic Acid	Glu	E
Glutamine	Gln	Q
Glycine	Gly	G
Histidine	His	H
Isoleucine	Ile	I
Leucine	Leu	L
Lysine	Lys	K
Methionine	Met	M
Phenylalanine	Phe	F
Proline	Pro	P
Serine	Ser	S
Threonine	Thr‘	T
Tryptophan	Trp	W
Tyrosine	Tyr	Y
Valine	Val	V

Amino Transferase: Enzyme capable of transferring amino groups from a donor molecule to a recipient molecule

Ammonia: Molecule containing a single nitrogen and three hydrogen atoms NH_3; becomes positively charged after gaining a proton, NH_4^+ which occurs at a pH value below the pK_a of 9.2

AMP: Adenosine monophosphate; ester of adenosine that contains a single phosphate group: derived generally from ATP with loss of diphosphate, from ADP with loss of a single phosphate or synthesized directly from adenosine

Amphipathic: Molecule or compound possessing both hydrophobic and highly polar (hydrophilic) regions or groups; for example, phospholipids with a polar head group and hydrophobic non-polar tails

Amylase: Any of a group of enzymes that catalyze the hydrolysis of starch and glycogen or their intermediate hydrolysis products

Anabolism: Defines biochemical processes that are synthetic producing compounds of greater complexity than the substrates; opposite of catabolism

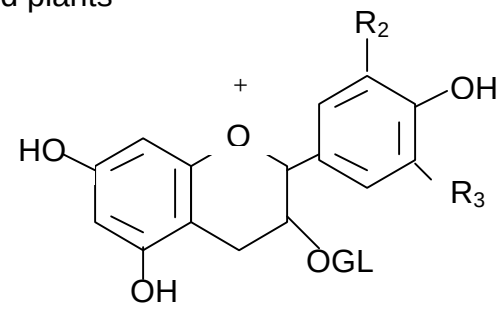
Analyte: In an assay, refers to the species being analyzed; the target of the analysis

Anaplerotic: A special class of enzymes involved in the insertion of one carbon (CO_2) or two carbon (acetyl CoA) molecules during biosynthesis

Anion: An ion carrying a net negative charge

Anthesis: To bloom; the opening of a flower

Anthocyanin: any of various soluble glycoside pigments producing blue to red coloring in flowers and plants



"OGL" = O glucoside

Cyanidin: R_2 = OH; R_3 = H

Delphinidin: R_2, R_3 = OH

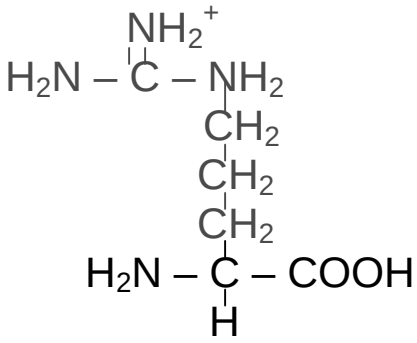
Malvidin: R_2, R_3 = OCH_3

Peonidin: R_2 = OCH_3, R_3 = H

Petunidin: R_2 = OCH_3, R_3 = OH

Antioxidant: General term for a compound that blocks oxidation reactions either by inhibiting the process chemically by reacting with the oxidizing agent or by affecting the activity of enzymatic oxidation processes

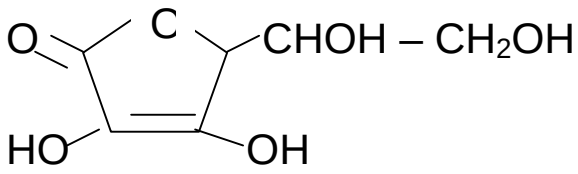
Arginine: A basic amino acid containing four nitrogen moieties; can pick up a proton and become positively charged at physiological pH; 3 letter code: Arg; 1 letter code: R; mw: 174.20; pKa: 2,17; 9.04 (α amino); 12.48 (guanidino); pI: 10.76



Aroma: Odor in wines related to grape as opposed to originating during the process (bouquet)

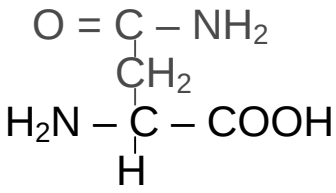
Ascomycete: Any of a class (Ascomycetes) or subdivision (Ascomycotina) of higher fungi (as yeasts or molds) with septate hyphae and spores formed in sacs or asci

Ascorbic Acid: Vitamin C; a naturally occurring antioxidant used in enzymatic reactions as a cofactor; used as an antioxidant in wine

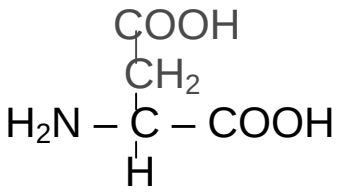


Ascus: plural **asci**: a membranous sac that holds sexual spores in fungi

Asparagine: A polar amino acid containing two nitrogen moieties; 3 letter code: Asn; 1 letter code: N; mw: 132.12; pKa: 2.02; 8.8; pI: 5.41



Aspartate: An acidic amino acid; 3 letter code: Asp; 1 letter code: D; mw: 133.1; pKa: 2.09 (α carboxyl); 3.86 (β carboxyl); 9.82; pI: 2.97



Assimilable: As in assimilable nitrogen: refers to compounds that can be utilized as building blocks for new cell material by an organism

Astringent: A compound or substance able to draw together the soft organic tissues leading to an unpleasant puckering or dryness of the mouth

Atomic weight: Number indicating the relative mass of an element as compared to an atom of carbon, C^{12}

ATP: Adenosine triphosphate; an ester of adenosine that contains three phosphate groups; supplies energy for many biochemical cellular processes by undergoing enzymatic hydrolysis especially to ADP

Autoclave: Instrument used to assure sterilization of solid or liquid materials; uses pressurized steam to kill viruses, molds, yeasts, bacteria and their spores; takes advantage of fact that moist heat is more penetrating of living materials than dry heat; normally 121°C for 15 to 20 minutes (depending upon volume/mass)

Autolysis: Process of self-lysis of yeast cells; hydrolytic enzymes released from the vacuole digest the cell wall and plasma membrane leading to the release of cytoplasmic components

Avogadro's Number: The number of atoms contained in a mole: 6.023×10^{23}

BAC: Has two meanings with respect to wine production: Blood Alcohol Concentration, a measure of the ethanol content of the blood stream; Bacterial Artificial Chromosome: used to make libraries of DNA fragments of eukaryotic organisms; BAC libraries of grape genomic DNA exist and can be used in the identification and isolation of individual grape genes

Bacteria: Microorganisms not containing a membrane bound nucleus; generally possess a single circular chromosome; any member of the eubacteria or archaebacteria; the prokaryotes

Bacteriocidal/Fungicidal: Antimicrobial agent leading to the loss of viability (death) of a bacterium (bacteriocidal) or fungus (fungicidal)

Bacteriophage: Also simply called phage: a virus-like particle that infects bacteria

Bacteriostatic/Fungistatic: Agent inhibiting the growth of a bacterium (bacteriostatic) or fungus (fungistatic) but that is not lethal, not leading to loss of viability

Balling: Density scale based upon weight percent sugar at 17.5°C

Base: A compound that can accept a proton becoming positively charged; an electron pair donor

Baume: Density scale based upon salt solutions at 20°C versus sucrose;
Baume = 0.018 = 0.5532Brix at 20°C

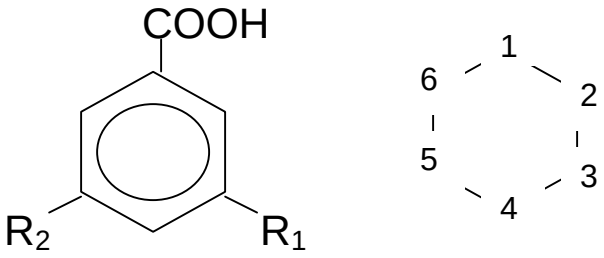
Beer-Lambert Law: Expression of the relationship between the amount of light absorbed by a solution (A) and concentration of analyte in a solution

$$A = \text{Log}\left[\frac{I_0}{I}\right] = \varepsilon cl$$

Where I_0 is the incident (incoming) light intensity; I is the transmitted light intensity; ε is the molar absorptivity (extinction coefficient) the amount of light absorbed by a 1M solution of the compound; c is the concentration of the compound in the solution in moles/L and l is the path length, usually 1 cm; A = absorbance

Bentonite: Clay used as a fining agent; aluminum silicate possessing exchangeable cations such as sodium, calcium and magnesium; effective in the removal of protein from wine

Benzoic Acid: Antimicrobial agent not approved for use in wine in the US, but that has been approved for other foods and beverages; carboxylated benzene ring



Common wine benzoic acid derivatives:

If the 4 position carries a hydroxyl, then *p*-hydroxybenzoic acid: R_1, R_2 = H; *p* – pyrocatechuic acid: R_1 = H, R_2 = OH; gallic acid: R_1, R_2 = OH; vanillic acid: R_1 = H, R_2 =

OCH_3; syringic acid R_1,R_2 = OCH_3

If the hydroxyl group is at position six adjacent to the carboxyl group, salycilic acid: R_1, R_2 = H; *o*-pyrocatechuic acid: R_1 = OH, R_2 = H; gentisic acid: R_1 = H, R_2 = OH

Biofilm: Generally a single cell layer of microbial growth coating the surface of a solid object; organisms are held together in the mat by exocellular polysaccharides

Biogenic Amine: Generally toxic amino compounds (histamine, tyramine, phenethyl ethylamine, putrescine, cadaverine) of biological origin from the decarboxylation of amino acids (histidine, tyrosine, phenylalanine, arginine, lysine); in wine generally derived from metabolism of lactic acid bacteria

Biotin: A vitamin (Vitamin H) and growth requirement for yeast and humans; coenzyme for carboxylation reactions

Bisulfite: HSO_3^-

Bitartrate: Refers to potassium bitartrate: KHTartrate; potassium tartrate is K_2Tartrate and tartaric acid is H_2Tartrate

Bitterness: Possessing an acrid or disagreeable taste

Blank: In spectrophotometric analyses it is important to calibrate the reading of the spectrophotometer against a sample not containing any of the analyte called a blank; this allows for detection of background interferences; water may served as a blank; calibrating the low end of the spectrophotometer, that is, setting the limits of detection of a reading

Blue Fining: Use of potassium ferrocyanide to remove copper from wine; not legal everywhere

Bordeaux Mixture: Mixture of copper sulfate and calcium hydroxide used in the vineyard as an anti-fungal agent

Botrytis: Refers to *Botrytis cinerea;* also called noble mold or noble rot; a fungus that infects grape berries; the fungus is able to penetrate the berry skin leading to the rapid loss of water from the fruit

Botrytized: Refers to wines that have been made from fruit infected with *B. cinerea*

Bouquet: Odor arising in wine from the processing of the juice, must or wine as opposed to originating in the fruit, as in fermentation bouquet or bottle bouquet

Bovine Serum Albumin (BSA): An albumin from cow serum commonly used as a

standard in biochemical assays

Brettanomyces: Also called “Brett”; a spoilage yeast most frequently found in barrels or wooden vats; imperfect (non-sexual spore forming) form of *Dekkera*

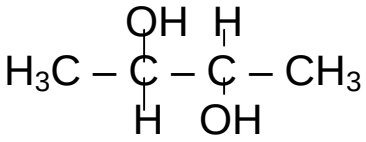
Brix: Relative density scale based upon weight percent (g sucrose/100g of solution) of sucrose at 20°C

Buffer: Refers to a compound or a solution of the compound or of a mixture of compounds that resists changes in pH brought about by the addition of small quantities of acid or base; compounds generally display buffering capacity in the pH range +1 to –1 unit surrounding the pKa value; generally comprised of a weak acid or base and a salt of that acid or base

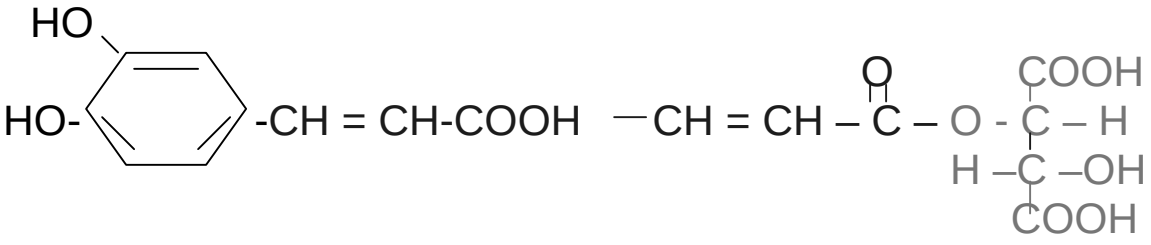
Buffering Capacity: Refers to the strength of a buffer, that is, how much acid or base must be used to effect a change in pH

Bureau of Alcohol Tobacco and Firearms (BATF): In the federal Department of the Treasury, the agency responsible for control and regulation of wine production, marketing and labeling, and collection of taxes

Butanediol: 2,3-butanediol; a metabolite produced by lactic acid bacteria, generally below the threshold of detection



Caffeic Acid: Phenolic hydroxycinnamate found in grapes and wine, primarily as a conjugate with tartaric acid, caftaric acid



Caffeic Acid Caftaric Acid

Calcium: Element with an atomic number of 20 and an atomic weight of 40.08; an essential micronutrient required in numerous biological processes

Calibration: Process of adjusting the response of an instrument to the amount of analyte present in a solution of known composition; for example, using solutions of

known pH to calibrate the output of a pH meter; may need to be done periodically, daily or even as each set of samples is analyzed

Candida: A genus of yeast commonly found on grapes and in wineries; may be an agent of spoilage, but is rarer than other types of spoilage

Capillary Electrophoresis: Electrophoretic separation of molecules in a capillary using simple salts in a liquid matrix through which a current is passed (See electrophoresis)

Carbodoser: A method for measuring CO_2 in wine based upon use of agitation to remove dissolved CO_2 to the gas phase then assessing the pressure released which is equivalent to the amount of CO_2 present

Carbohydrate: A general term for molecules with the formula $(CH_2O)_n$; includes simple sugars and complex polysaccharides

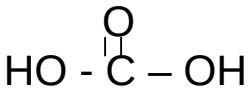
Carbon: Element of the periodic table with an atomic number of 6 and an atomic weight of 12.01

Carbonation: The process of addition of carbon dioxide

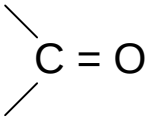
Carbon Dioxide: A molecule containing one atom of carbon and two of oxygen: CO_2; an end product of oxidative degradation of organic molecules, and used as a precursor of organic molecules in photosynthesis

Carbonic: General term meaning of, relating to, or derived from carbon, carbonic acid, or carbon dioxide

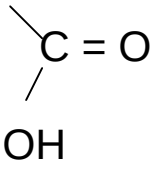
Carbonic Acid: A molecule containing one carbon atom with two hydroxyl groups and a double bond to an oxygen molecule



Carbonyl: An organic functional group occurring in aldehydes, ketones, carboxylic acids, esters, and their derivatives



Carboxylic acid: An organic acid (as acetic acid) containing one or more carboxyl groups

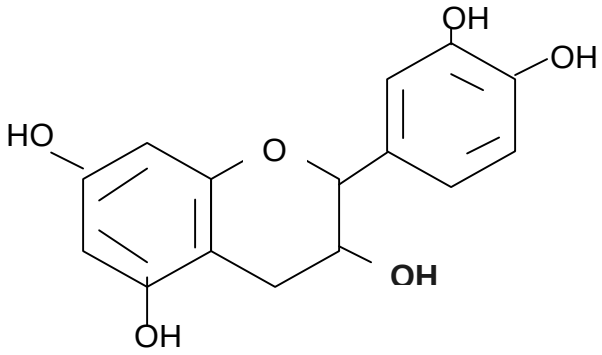


Casein: Protein fining agent derived from milk; a mixture of α casein, β casein, ε casein and τ casein

Casse: Precipitate formed in wine from the action of metal ions, principally copper and iron

Catabolism: Defines biochemical processes that are degradative or destructive involving the release of energy and resulting in the breakdown of complex materials within the organism; opposite of anabolism

Catechin: A flavan-3-ol found in wine as one of the principle phenolic compounds; differs from epicatechin in the orientation of the hydroxyl group at the three position of the C ring



Cation: An ion carrying a net positive charge

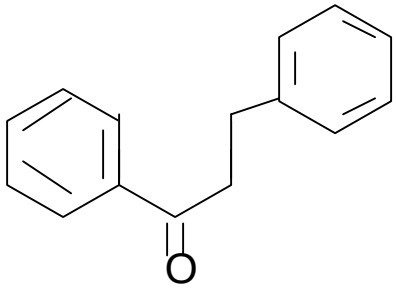
Cellulase: An enzyme that hydrolyzes cellulose, a structural polysaccharide

Cellulose: Structural polymer of glucose found in plants; cellulose fibers are used as a matrix in wine filtration

Cell Wall: The outermost layer of a yeast, fungal or plant cell; provides rigidity and physical protection; in yeast comprised largely of polymers of protein and mannose (mannan, mannoprotein); polymers of glucose (glucan); plant cell walls contain cellulose as a major component; fungi also contain chitin as a component of the cell walls

Centrifugation: The use of centrifugal force to separate particles with a heavier mass from a solution; used for clarification of wines; the solid material is referred to as the pellet and the clarified liquid phase is called the supernatant

Chalcone: An open ring form of a flavonoid molecule



Chaptilization: Term for the addition of sugar to must; not legal in all areas

Chelating Agent: A compound that can bind to or absorb metal ions; important in enzymatic catalysis

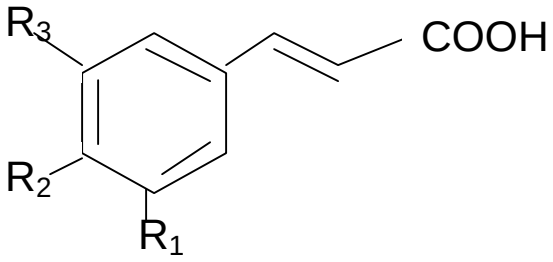
Chitin: A β1,4 linked polymer of N-acetylglucosamine; found in the cell walls of fungi; in yeast, found at the site of cell separation, the bud scar

Chlorine: An element with an atomic number of 17 and an atomic weight of 35.45; used as a sanitizing, cleaning or bleaching agent in wine production; chlorine gas is toxic; care must be taken to not generate a toxic gas by mixing chlorine solutions with other solutions

Chromatography: Method for the separation of molecules in a mixture that employs a solid and mobile phase; takes advantage of differences among molecules in partition coefficients, mass, and other interactive properties; five basic types of chromatography: paper chromatography, thin-layer chromatography, column chromatography, gas chromatography, liquid chromatography (HPLC, High Performance Liquid Chromatography; vary in nature of the solid support and the mobile phase (gas or liquid)

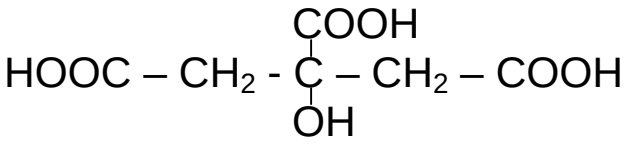
Chromosome: Linear DNA molecule segregating as a single unit during cell division; carries information specifying functional RNA or protein molecules arrayed in genes; each chromosome has a singe centromere and two ends or telomeres

Cinnamic Acids: Phenolic compounds found in wine with the general structure



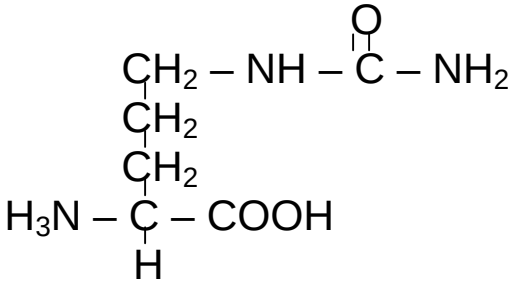
Common cinnamic acids found in wine: cinnamic acid: R_1,R_2, R_3 = H; caffeic acid: R_1, R_2 = OH, R_3 = H; *p*-coumaric acid: R_1, R_3 = H, R_2 = OH; ferulic acid: R_1 = OCH_3, R_2 = OH, R_3 = H; sinaptic acid: R_1, R_3 = OCH_3, R_2 = OH

Citric Acid/Citrate: Intermediary metabolite found universally in prokaryotes and eukaryotes



Citric Acid Cycle: Also known as the tricarboxylic acid or TCA cycle; a series of energy- yielding enzymatic reactions by which pyruvate or the acetate of acetyl CoA is oxidized to CO_2 and H_2O; reoxidation of cofactors (NADH, $FADH_2$) reduced in this process generates energy in the form of ATP in the electron transport chain of the mitochondria; oxygen serves as terminal electron acceptor for this process which is known as respiration; the citric acid cycle is also involved in anabolic and catabolic reactions in the generation of precursors or degradation products of several metabolites; also used for the net synthesis of glucose during the process of gluconeogenesis

Citrulline: Compound that is both a metabolite of and precursor of the amino acid arginine; implicated in ethyl carbamate formation by lactic acid bacteria



Clone: Refers to organisms that are genetically identical and usually derived not using sexual reproduction; in grape refers to vines that have been propagated by cuttings and

are therefore genetically identical rather than being derived from seeds

Coefficient of determination (r^2): The square of the correlation coefficient; used with regression analysis; gives an estimate of the proportion of the total variance that is attributable to the independent variable, x

Coenzyme: Any one of several complex organic molecules required for enzymatic activity

Coenzyme	Role/Target/Entity transferred
NAD/NADH	H atoms (electrons)
NADP/NADPH	H atoms (electrons)
FAD	H atoms (electrons)
FMN	H atoms (electrons)
Coenzyme Q	H atoms (electrons)
Coenzyme A	Acyl groups
Lipoamide	Acyl groups
Cobamide coenzymes	Alkyl groups
Biotin	Carboxyl groups
Pyridoxal Phosphate	Amino groups
Tetrahydrofolate	C_1 transfers
Thiamin Pyrophosphate	Aldehydes

Coenzyme A (CoA): Coenzyme functioning as a carrier of acyl groups in anabolic and catabolic reactions

Cofactor: Compound or element required for the activity of an enzyme; generally a coenzyme or metal ion: B, Ca, Co, Cu, Fe, K, Mg, Mn, Mo, Na, Se, Zn

Colloid: Suspended particles; partially soluble components the distribution of which between soluble and insoluble phases is dependent upon temperature and properties of the particle and the solution; colloidal particles tend to adhere to other substances also holding them in solution

Condensed Polyphenol: Polymers of polyphenolic (more than one hydroxyl group on a benzene ring) structures; more general than condensed tannin

Condensed Tannin: Polymer of flavonoids linked by a carbon to carbon bond; formed by non-oxidative polymerization

Cooperage: A general term for wooden containers found in wineries that hold juice, must or wine; made by a cooper

Copigmentation: Solution phenomena with respect to wine color whereby dilution

leads to a greater loss of absorbance of the solution than predicted from a simple linear relationship; due to complex association of colored and non-colored phenolic components in wine with the complexes displaying different color properties such as wavelength of maximal absorption than the dissociated units; copigment: term for the non-colored components in the complex

Copper: A metallic element with an atomic number of 29 and an atomic weight of 63.55; important in wine in the removal of H_2S and other sulfides and as a causative agent of casse

Cordon: Term for the main branch of the trunk of a vine; bearing wood arm of a trunk

Correlation Coefficient (r): Measure of the tendency of two variables to vary together; does not imply co-dependence merely that they vary together; An r value of 1.000 indicates a perfect linear relationship; can be determined from a plot of the two variables against each other; see coefficient of determination (r^2)

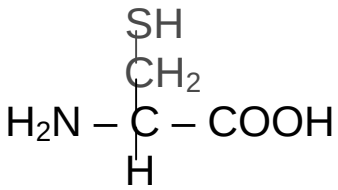
Covalence: Valence characterized by the sharing of electrons

Covariance: Measure of the tendency of two variables to vary in the same way

Cultivar: An organism of a kind originating and persistent under cultivation

Cycloheximide: Fungicide inhibiting protein synthesis in eukaryotic cells at the 80S ribosome; some yeast strains (*Dekkera*/*Brettanomyces*) are resistant to this compound; used primarily to detect Brett in wines

Cysteine: A non-polar sulfur-containing amino acid; 3 letter code: Cys; one letter code: C; mw: 121.16; pKa: 1.71; 8.33 (sulfhydryl); 10.78 (α amino); pI: 5.02



Cystine: A dimmer of two cysteine molecules formed via bonding of the sulfur groups; mw: 240.3

Cytoplasm: The organized complex of inorganic and organic substances external to the nuclear membrane and internal to the plasma membrane of a cell and including the cytosol and membrane-bound organelles

Deacidification: The reduction of the acidity of a juice, must or wine

Deaminate: To remove the amino group from (a compound)

Decanoic Acid: Short chain saturated fatty acid containing 10 carbon atoms; produced by yeast and inhibitory to yeast and fungi at high concentrations

$$CH_3(CH_2)_8COOH$$

Deficit Irrigation: Water taken up from the soil by a plant root system is lost from the foliage via the process of transpiration, or more correctly, evapotranspiration; evapotranspiration is the driving force for the vascular circulation of the plant; full irrigation means that the process of evapotranspiration is not limited by the available water but by climatic (temperature, humidity) and plant (density of foliage) factors; deficit irrigation means supplying water at a level below that allowing maximal evapotranspiration; requires knowing evapotranspirative rates, humidity and soil water status

Dekkera: A genus of yeast found associated with wooden cooperage and that is capable of producing distinctive aromas; the perfect (sexual spore-forming) form of *Brettanomyces*

Delle Unit: Describes the potential for stability against microbial activity of a dessert wine as a function of the ethanol and sugar content; Delle Unit (DU) = % sugar(w/v) + 4.5(% alcohol [v/v]); to be effective the DU needs to be a value of 78 or higher

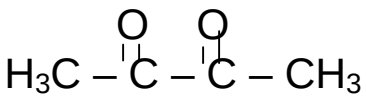
Density: Defines the mass of a substance per unit volume: i.e., g/cm^3 or g/mL

Destemming: Refers to the separation of grapes from stems of a cluster

Dextrorotary: An optically active substance is one that rotates the plane of polarized light; if that rotation is to the right or clockwise the substance is dextrorotary

Dextrose: Alternate term for glucose coined because it is dextrorotary

Diacetyl: Metabolite principally from lactic acid bacteria but that can be produced by yeast; derived from acetyl CoA and active acetaldehyde or following decarboxylation of the 5 carbon molecule α acetolactate; responsible for a buttery or popcorn/rancid butter note

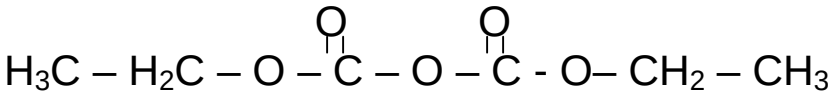


Diammonium Phosphate (DAP): $(NH_4)_2HPO_4$; Form of nitrogen commonly added to wine to stimulate yeast fermentation and to prevent hydrogen sulfide formation; legal limits of addition vary by country of production; in the United States: 1 lb/1000 gal (0.96

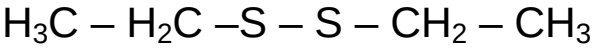
g/L)

Diatomaceous Earth (DE): Matrix for the filtration of wine derived from microscopic fossilized algae known as diatoms and available in different particle sizes

Diethyl Dicarbonate (DEDC): Antimicrobial agent leading to the formation of the carcinogen ethyl carbamate upon reaction with amines; no longer approved for use in wine production



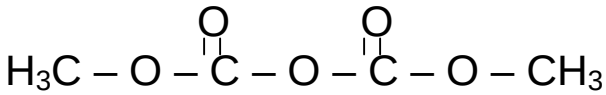
Diethyl Disulfide (DEDS): Volatile sulfur compound arising during or after yeast fermentation thought to derive from oxidation of methyl mercaptan; reminiscent of burnt rubber or garlic



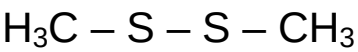
Dihydro: Combined with two atoms of hydrogen

Dimer: Chemical or protein species comprised of two molecules associated with each other via chemical bonding

Dimethyl Dicarbonate (DMDC): Antimicrobial (especially effective against yeast) agent used in juices, musts and wines; commercially available as Velcorin; hydrolyzes to methyl carbamate, ethanol and carbon dioxide; should be used with caution – any water in solution of methyl carbamate will lead to hydrolysis and the formation of very high pressures of CO_2 leading to explosion of the container



Dimethyl Disulfide (DMDS): Volatile sulfur compound arising during or after yeast fermentation thought to derive from oxidation of methyl mercaptan; reminiscent of cooked cabbage



Dioecious: Not self-fertile; having male reproductive organs in one individual and female in another; in plants, means staminate and pistillate flowers are borne on different individuals

Diploid A single cell, individual, or generation characterized by having two complete sets of chromosomes; also called “2N”.

Disaccharide: Term for molecule containing two sugar moieties; sucrose is a

disaccharide composed of one molecule each of glucose and fructose; trehalose and maltose are disaccharides of glucose differing in the linkage of the two sugars; lactose and melibiose are disaccharides of galactose and glucose differing in the linkage of the two sugars

Dissociation Constant: See Equilibrium Constant

Dissolved Oxygen: Oxygen content found in the liquid phase

Disulfide: General term indicating two sulfur groups occur in the molecule and are bound to each other

$$R_1 – S – S – R_2$$

DNA: Deoxyribonucleic acid; macromolecule comprised of purine and pyrimidine bases that carries genetic information and specifies RNA and protein sequence

Dose Response Trial: General term for an experiment with the goal of defining the magnitude of the response based upon the concentration of a substance present; for example, used with fining agents to determine the concentration of the agent needed to achieve heat stability

Dry: Refers to wine lacking fermentable hexose sugar, generally less than 2 g/L

Ebuillometry: Analytical method determining the concentration of a substance due to a change in the boiling point of water; in wine, used to measure ethanol; ethanol reduces the boiling point of water

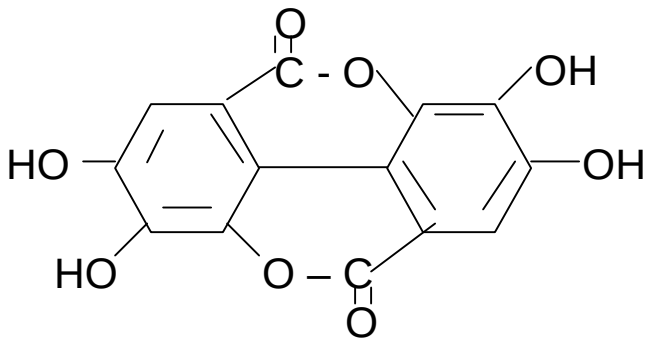
Electron Transport Chain: In respiration, a series of carriers through which electrons of initial high energy are converted to a lower energy state with the capture of the released energy as ATP; occurs in the mitochondria in eukaryotic cells; the terminal electron acceptor is molecular oxygen, producing water in plants, animals, and fungi and in many (but not all) bacteria

Electrophoresis: Analytical and preparatory technique separating mixtures of molecules taking advantage of migratory behavior in an electric field which is a function of mass, charge, and shape; may be through a liquid, gel or gas phase; net negatively charged ions move towards the anode; positively charged ions toward the cathode; principle behind capillary electrophoresis (CE), and protein/peptide separation by sodium dodecylsulfate (SDS) polyacrylamide gel electrophoresis (SDS-PAGE) and the electrophoretic separation of DNA and RNA molecules and fragments or their derivatives

ELISA: Enzyme Linked ImmunoSorbent Assay; method of quantitation of a component based upon its antigenicity, that is, its reactability with antibodies; the antibodies bind to the antigen in a concentration dependent manner; in an ELISA another component or

marker that is detectable (enzymatically or colorometrically) is associated with the primary antibody allowing quantification of the amount of antibody in the complex by quantification of the readily detected bound marker, which is then related to the amount of the substance (antigen) being analyzed

Ellagic Acid: Dimer of gallic acid produced from the hydrolysis of ellagitannins; in wine thought to derive from oak rather than grapes; can form a crystalline precipitate in barrel aged wines during storage in the bottle



Endocarp: The inner layer of the pericarp of a fruit (as an apple or orange) when it consists of two or more layers of different texture or consistency

Endoplasmic Reticulum: A membranous organellar structure found in eukaryotic cells involved in the synthesis and modification of membrane-bound, membrane-associated; organellar and secreted proteins

Enzyme: Any of numerous complex proteins that are produced by living cells and catalyze specific biochemical reactions; enzymes catalyze reactions by reducing the energy of activation(energy needed to reach a high energy transition state) required, that is, create an energy rich state of the reactants; enzymes are divided into several classes depending upon the nature of the reaction catalyzed; indicated by use of the suffix “-ase”; holoenzyme (active enzyme complex): refers to the enzyme plus any required cofactors; apoenzyme: the enzyme in the absence of required cofactors (generally inactive)

Enzyme Class	Reaction Catalyzed	Substrates
Hydrolases	Hydrolysis (addition of water)	Acid Anhydrides Esters Glycosidic Bonds Peptide (C-N) Bonds
Isomerases Racemases	Isomerization reactions	Amino Acids and Derivatives Hydroxy Acids and Derivatives Carbohydrates
Ligases	Formation of covalent bonds usually at the expense of a high energy phosphate (ATP) molecule	C,C → C-C C,N → C-N C,O → C-O C,S → C-S
Lyases	Addition reactions to double bonds	C=C C=O C=N
OxidoReductases Dehydrogenases Hydroxylases Oxidases Reductases	Oxidation – reduction reactions	$-CH_2OH$ -C=O -CH=CH- $-CH_2NH_2$ -CH=NH NADH/NADPH
Transferases Kinases (PO_4)	Transfer of functional groups	Acyl groups Aldehydic groups Amine/o groups Glycosyl groups Ketonic groups One carbon groups Phosphate/phosphorylated protein S-containing groups

Epicatechin: A flavan-3-ol found in wine; see catechin

Equilibrium Constants: Many chemical and biochemical reactions do not proceed to completion but instead reach an equilibrium condition at which point the forward and reverse reactions occur at the same rate such that there is no net change in substrate(s) or product(s) concentrations. There are many factors that influence the establishment of equilibrium. The Principle of Le Chatelier states that equilibrium will

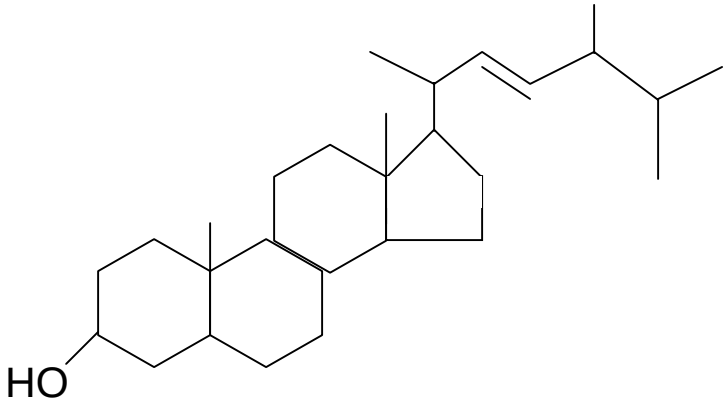
shift in the direction that counteracts the applied force. For example, increasing temperature will favor the reaction that absorbs heat. There are many types of chemical and biochemical equilibria. Each type has an equilibrium constant, K, that describes numerically the relationship between the forward and reverse reactions. A large K value means the reaction is favored in the direction of that reaction while a low K value indicates that the opposite reaction is favored.

Type of Equilibrium	Reaction	Equilibrium Constant Expression	Equilibrium Constant
Water Dissociation	$2H_2O \rightleftharpoons H_3O^+ + OH^-$	$K_w = [H_3O^+]\,[OH^-]$	K_w: Ion product constant
Acid-Base Dissociation	$HA \rightleftharpoons H^+ + A^-$	$K_a = \frac{[H^+]\,[A^-]}{[HA]}$	K_d, K_a, K_b: Acidity (dissociation) constant
Solubility: distribution in solid and liquid phases	$MX_2 \rightleftharpoons M^+ + 2X^-$	$K_{sp} = [M^+]\,[X^-]^2$	K_{sp}: Solubility product
Phase Distribution: two liquid phases	$A_{H2O} \rightleftharpoons A_{organic}$	$K_D = \frac{[A_{organic}]}{[A_{H2O}]}$	K_D: Distribution (partition) coefficient
Complex Formation	$M^{n+} + aX^{b-} \rightleftharpoons MX_a^{(n-}$ ab)T	$K_f = \frac{[MX]}{[M^{n+}]\,[X^{b-}]^a}$	K_f: Formation constant
Oxidation-Reduction	$A_{red} + B_{ox} \rightleftharpoons A_{ox} + B_{red}$	$K_{eq} = \frac{[A_{ox}]\,[B_{red}]}{[A_{red}]\,[B_{ox}]}$	K_{eq}: Reaction equilibrium constant

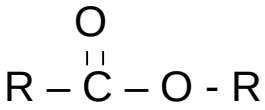
Equivalent Weight: Important concept in determining the concentration of a compound or element using titration with a known concentration of a second compound or element; always refers to a specific chemical reaction; the equivalent weight for a neutralizing or acid base titration is that weight which either contributes or reacts with one gram molecular weight of hydrogen ion; in this case, H_2SO_4 donates two protons and its equivalent weight is half that of its formula weight; equivalent weight in an oxidation reduction reaction is that which consumes or produces one mole of electrons; the equivalent weight in a precipitation reaction is that weight that reacts with or provides 1 g molecular weight of the reacting cations if univalent, ½ the molecular weight if divalent, etc.

Ergosterol: Type of sterol found in yeast; has both a bulk or structural role in

maintaining membrane integrity and a regulatory role; molecular oxygen is required for synthesis; bulk function can be fulfilled by animal or plant sterols but the regulatory function requires ergosterol specifically



Ester: Any of a class of often aromatic compounds that can be represented by the formula:

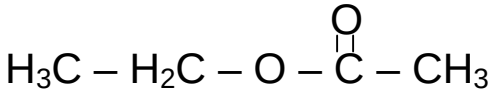


formed by the reaction between an acid (as an acyl CoA) and an alcohol with elimination of water

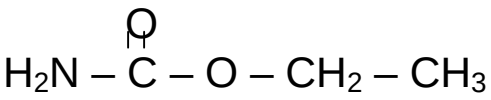
Ether:: Flammable liquid used chiefly as a solvent and anesthetic; any of various organic compounds characterized by an oxygen atom attached to two carbon atoms – C – O – C -; ethyl ether: $H_3C – H_2C – O – CH_2 – CH_3$

Ethyl: a univalent hydrocarbon group composed of two carbon and five hydrogen atoms $-CH_2CH_3$

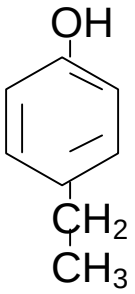
Ethyl Acetate: Ester of ethanol and acetic acid; most prevalent fermentation bouquet ester in wine; produced by both yeast and bacteria



Ethyl Carbamate: Carcinogen of natural biological origin found in all fermented foods and beverages; generated from the interaction of ethanol and a carbamyl group donor such as urea; minimal acceptable levels have been set in many countries for table and dessert wines and distillates



4-Ethyl Phenol: Compound produced by *Brettanomyces*/*Dekkera* that has been used as an indicator of the presence and level of activity of these yeasts



Ethanol: colorless volatile flammable liquid that is the intoxicating agent in liquors and is also used as a solvent -- called also ethyl alcohol, grain alcohol; CH_3CH_2OH

Eukaryote/Eucaryote: An organism composed of one or more cells containing visibly evident membrane bound nuclei and organelles – all complex multicellular organisms, including animals, fungi and plants, are eukaryotes; see prokaryote

Eutypa lata: Species of fungus infecting grape vines usually via pruning wounds responsible for “dead arm” or the death of a cordon

Exocarp: The outermost layer of the pericarp of a fruit

Exponential (Logarithmic) Growth: Refers to growth of microorganisms which fits the following relationship: $N_n = 2^n N_0$ where N is the cell number, N_n the cell number after “n” generations, N_0 the initial cell number

Extract: Non-volatile dissolved components of juice or wine; includes but is not limited to sugar; contributes to estimates of density or specific gravity

FAD: Flavin adenine dinucleotide; cofactor involved in oxidation/reduction reactions

FAN: See free amino nitrogen

Fatty Acid: Straight chain saturated or unsaturated carbon compounds containing an even number of carbon atoms and built from condensation of acetyl CoA units with a terminal carboxyl COOH group

Fermentation: Use of a carbon compound as terminal electron acceptor in catabolism of substrates; process is therefore anaerobic

Fermenter: Refers to an agent of fermentation such as yeast or bacteria

Fermentor: Apparatus for fermentation

Ferric Tannate (Blue Casse): If tannin is found at high concentration in the presence of iron and oxygen, a colloidal material that may form

Film Yeast: General term for yeast capable of forming a film on the surface of wine; most commonly members of the genera *Pichia* and *Candida*, especially *C. mycoderma* in table wines

Filtrate: Term for the liquid that passes through a filtration matrix

Filtration: The removal of particles from a liquid suspension by passing through a matrix; particles are removed by size exclusion (sieving; unable to enter matrix) or by absorption (attaching or sticking to the matrix); filtrations graded by exclusion limit, with rough filtrations having the largest pore sizes; sterile filtration matrices have an average pore size of 0.45 μm; ultrafiltration: very small pore sizes for the exclusion of macromolecular solutes (protein, tannin), with exclusion sizes from 1000 to 100,000 Daltons

Fining: Process of adding a substance to wine that is not soluble in the wine but that will clarify or remove soluble components from the wine

Fixed Acidity: Term for the non-volatile acid species present in wine, malate, tartrate, citrate, etc.

Flavane – diol: See flavonoid structure, compounds possessing hydroxyl groups (OH) at both the 3 and 4 carbons of the bridge

Flavanol/Flavan-3-ols: See flavoniod structure; compounds possessing a hydroxyl group (OH) at the number 3 position of the bridge between the two benzene rings

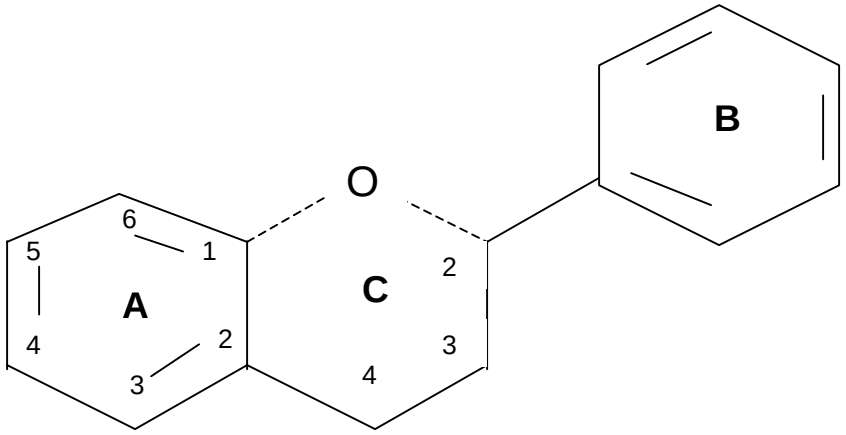
Flavanone: See flavonoid structure; compounds possessing a carbonyl group (= O) at the 4 position of the bridge

Flavanonol: See flavonoid structure; compounds possessing a carbonyl group (= O) at position 4 of the bridge and a hydroxyl group (OH) at position 3 of the bridge

Flavone: See flavonoid structure; compounds possessing a double bond between carbons 2 and 3 of the bridge and a carbonyl group (= O) on position 4 of the bridge

Flavonoid: any of a group of aromatic compounds that includes many common pigments (as the anthocyanins and flavones); characterized by having 15 carbons

arranged as two six carbon benzene rings separated by a 3 carbon bridge; the bridge can be closed via linkage of carbon one of the lower benzene ring to carbon 2 of the bridge via an oxygen molecule forming a pyran ring, ring C (see anthocyanin structure)



Flavonol: See flavonoid structure; compounds possessing a double bond between carbons 2 and 3 of the pyran ring, carbon 3 of the bridge has a hydroxyl group (OH) and carbon 4 of the bridge a carbonyl group (= O)

Flavylium Ion: See anthocyanin and flavanoid structures; term for the form of these compounds that have picked up a proton and therefore carry a positive charge around the bridge ring (ring C) formed via bonding of the carbons of the bridge and the lower benzene to oxygen

Flocculent: Refers to the ability of yeast cells in suspension to agglutinate or adhere to each other forming large visible masses of cells or flocs.

Flor: Term used to describe the film or mat of yeasts that forms on the surface of the wine during sherry production; flor yeast defines the yeast species capable of forming a flor and maturing the wine, currently called *Troulaspora delbrueckii*, former taxonomic names: *Saccharomyces beticus, S. cheriensis, S. chevalieri*

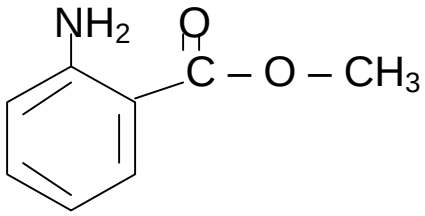
FMN: Riboflavin mononucleotide; cofactor involved in dehydrogenation reactions; riboflavin is an essential requirement of many organisms

Folin-Ciocalteu: Assay commonly used in wine to measure general phenol content; the reactant is phosphomolybdotungstic acid; will also react with tyrosine and can be used as a measure of protein content if no interfering phenolic substances are present

Formula Weight: Frequently molecules do not really exist in the form represented by their molecular structure, especially ionic species that may be associated with a water molecule. Formula weight is the term used to imply the weight based on the chemical

formula more correct than using the term molecular weight unless it is unequivocally known that the compound exists as indicated by the chemical formula

Foxy: Term used to describe the characteristic odor of North American native grape species; principally methyl anthranilate and related compounds: ethyl anthranilate, ethyl and methyl salicylate, 2-methoxy ethyl and methyl benzoate

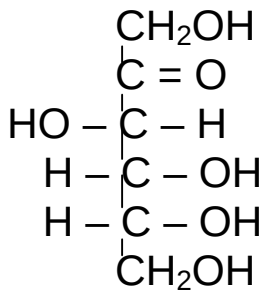


Methyl anthranilate

Free Amino Nitrogen (FAN): Sum of the species containing an α amino (or free) nitrogen in the molecule; many α amino compounds can be used by yeast as a source of nitrogen for biosynthesis, but not all, does not measure free ammonia but does measure amino groups in compounds not metabolizable by yeast; FAN is used as an estimate of the available or assimilable nitrogen for yeast growth and metabolism in wine production; roughly 140 mg/L of FAN is needed in order for yeast to complete a fermentation, 400 to 500 mg/L for attainment and maintenance of maximal fermentation rates

Free Radical: Chemical element or compound possessing a single unpaired and unshared electron; highly reactive as molecule will readily pick up or donate an electron to be more energetically stable; antioxidants can function by reaction with oxygen radicals; if antioxidant can then in turn donate the electron to another species it is called a prooxidant

Fructose: Optically active sugar that differs from glucose in having a ketonic rather than aldehydic carbonyl group; also called levulose; found as either a pyranose or furanose ring

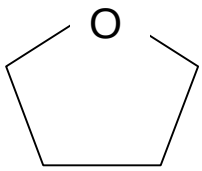


Fumaric Acid/Fumarate: Dicarboxylic four carbon acid; an intermediate in the citric acid (TCA) cycle; found in both prokaryotes and universally in eukaryotes; also derived

from the degradation of tryptophan; converted to malate by fumarase, to succinate by succinate dehydrogenase; antibacterial agent used to control the ML fermentation

$$HOOC – CH = CH - COOH$$

Furan: A five membered ring containing 4 carbons and one oxygen atom; furanose: having a structure based on a furan ring



Fusel Oil: Term for higher (greater than 2 carbon) alcohols; so named because of the foul smell upon distillation of these compounds; see higher alcohols

Gallic Acid: Phenolic compound derivative of benzoic acid found in wine; for structure, see benzoic acid

Gallic Acid Equivalent: Term used in the Folin-Ciocalteu assay to express the phenolic content of the sample analyzed; based on the use of gallic acid as a standard (see standard curve)

Gamma (γ) Aminobutyric Acid (GABA): Nitrogen containing compound produced by grapes which increases post-harvest and which serves as a good yeast nitrogen source

$$H_2N- (CH_2)_3 - COOH$$

Gas Chromatography (GC): Chromatographic technique using gas as the mobile phase for the separation of volatile compounds

Gelatin: Protein of animal origin used as a fining agent in wine processing; generally used in combination with another agent

Gene: A unit of inheritance; specifies a functional protein or RNA molecule

Genetic Engineering: The process of using *in vitro* (outside of the body or cell) techniques to modify the genetic composition of a target organism; generally with a very specific goal in mind

Genus, plural **genera:** Term used in taxonomy to specify a class, kind, or group marked by common characteristics; a category of biological classification ranking

between the family and the species, comprising structurally or phylogenetically related species or an isolated species exhibiting unusual differentiation, and being designated by a Latin or latinized capitalized singular noun

Geraniol: A terpene found in wine (see terpene for structure)

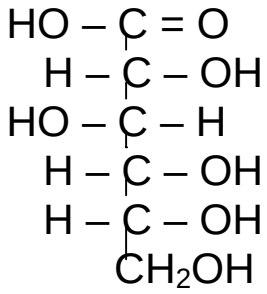
Glucan: Polymer of glucose found in yeast cell walls consisting of both β-1,3 and –1,6 linkages of glucose; can comprise up to 60% of the cell dry weight; insoluble in alcohol solutions, can cause haze in wine

Glucanase: An enzymes capable of the degradation of glucan; commercial preparations can express endo β-1,3 and β-1,6 glucanase activity and exo β-1,6 glucanase activity

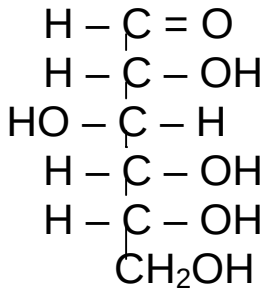
Glucoconjugate: A form of a molecule containing a carbohydrate (sugar) moiety; carbohydrate may be linked via an oxygen or a nitrogen molecule; the non-carbohydrate portion of the molecule is called the aglycone

Gluconeogenesis: When cells are grown on 2 and 3 carbon respiratory substrates (acetate, pyruvate, lactate, ethanol) they must synthesize glucose in order to make glucose containing polymers such as glucan, trehalose and glycogen and must have sugar for the glycosylation of proteins; the synthetic process for the generation of glucose is called gluconeogenesis; it involves “reversing” the citric acid cycle and glycolysis; many, but not all, of the enzymes of the glycolytic pathway are used in gluconeogenesis

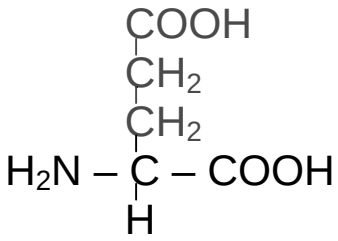
Gluconic Acid: Oxidation product of glucose; produced by fungi; used as a marker of fungal metabolic activity



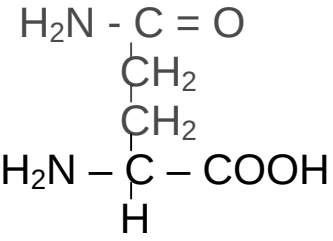
Glucose: Optically active sugar that has an aldehydic carbonyl group; sweet colorless soluble dextrorotory (dextrose) form that occurs widely in nature; the usual form in which carbohydrate is assimilated by animals; occurs in either a pyranose or furanose form



Glutamate/Glutamic Acid: An acidic amino acid; 3 letter code: Glu; 1 letter code: E; Mw: 147,13; pKa: 2.19 (α carbonyl); 4.25 (γ carbonyl); 9.67; pI: 3.22

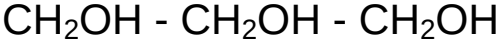


Glutamine: A polar amino acid related to glutamic acid, but containing an amino group rather than a carboxyl; 3 letter code: Gln; 1 letter code: Q; mw: 146.2; pKa: 2.17, 9.13; pI: 5.65



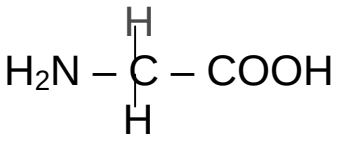
Glutathione: A tripeptide that contains one amino acid residue each of glutamic acid, cysteine, and glycine; occurs widely in microbial, plant and animal tissues; important in biological oxidation-reduction processes, maintenance of cellular redox status and as a coenzyme

Glycerol: Metabolite and intermediate found widely in prokaryotes and eukaryotes; thought to be associated with mouth feel in wine



Glycine: A non-polar amino acid; 3 letter code: Gly; 1 letter code: G; mw: 75.07; pKa:

2.34, 9.6; pI: 5.97



Glycogen: Polymer of glucose located in the yeast cytoplasm; serves as a reserve or storage form of carbohydrate; may also be involved in maintenance of cellular resistance to dehydration

Glycolysis: the enzymatic breakdown of a carbohydrate (as glucose) by way of phosphate derivatives with the production of pyruvic or lactic acid with the energy generated stored in high-energy phosphate bonds of ATP

Glycoprotein: A protein that has been glycosylated (chemically bound to carbohydrate)

Glycosidase: An enzyme that catalyzes the hydrolysis of a bond joining a sugar of a glycoside to an alcohol or another sugar unit

Glycosyl: Univalent radical derived from a cyclic form of glucose by removal of the hemiacetal hydroxyl group

Glycosyl-Glucose (GG): Terpenes and other aromatic compounds in grape are present in free and bound forms; bound means present as a glycoconjugate, generally to a disaccharide glucoside with glucose as the proximal sugar to the aglycone moiety (R-Glucose –Glycosyl); enzymatic tests for the presence of bound aroma precursors analyze the amount of glucosyl-glucose or GG released; principally found in mono- and sesquiterpenes, norisoprenoids, shikimic acid derivatives

Glycosylate: To add carbohydrate to a molecule or protein

Glycosylation: A general term meaning the process of adding covalently linked glycosyl or complex carbohydrate groups to a protein forming a glycoprotein

Glyoxylate Cycle: Pathway for the conversion of fatty acids to carbohydrate in higher eucaryotes; can be found in microbes as well although it may be used for a different purpose (equilibration of citric acid cycle intermediates; biosynthesis)

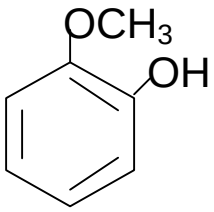
GMO: Acronym for “genetically modified organism”; generally implying that biotechnological tools were used to alter the genetic constitution (genome) of the organism as distinct from natural breeding and selection

Golgi Bodies: Subcellular organelles involved in the modification, maturation, processing and sorting of proteins and lipids for secretion or translocation to the plasma

membrane or vacuole; follows the endoplasmic reticulum in the process of secretion; site of protein modification: glycosylation

GRAS: Acronym standing for “generally recognized as safe”; a component for which there is no known health risk and which has been part of the human diet for generations

Guaiacol: L-methoxy phenol; *o*-hydroxyanisole; compound sometimes found on cork thought to impart a smokey character; generally present below threshold of detection



Halogen: Any one of the elements of the periodic chart from group VIIA: fluorine, chlorine, bromine, iodine, astatine; normally occurring in diatomic form, i.e. Cl_2

***Hanseniaspora*:** Genus of yeast found on the surface of grapes; perfect or sexual spore forming ascomycete; *H. uvarum* is the most common species and the perfect form of *K. apiculata*

***Hansenula*:** Genus of yeast found on the surface of grapes; perfect or sexual spore forming ascomycete; several different species may be found

Haploid: Organism having a single set of chromosomes or 1N

Haze: Visible cloudiness forming in wine or juice; may be from a variety of sources

Head Space: The air space above the liquid phase in a container; see ullage

Heat Stability: Refers to wine that does not produce a haze upon heating to a high temperature followed by rapid cooling

Heavy Metal: Any one of a variety of elements of the periodic chart producing insoluble sulfides; alternately refers to transition and post-transition elements; some are trace elements required for cellular growth and metabolism (i.e., Cu, Fe); toxic at high concentrations; causative agents of casse in wine

Hectare: An are is an area 10 m by 10 m or 100 sq m; a hectare is 100 m by 100 m or 10,000 sq m or 2.47 acres

Hectoliter: 100 liters

Heme: Coenzyme derived from a metal ion (usually Fe) and a porphyrin ring; important in oxidation reactions and in oxygen transfers

Hemicellulose: Highly branched polysaccharide component of plant cell walls along with pectin and cellulose; polymer of glucose and xylose (xyloglucan) with a backbone of glucose molecules linked to a side chain of xylose with some galactose and fucose

Heterofermentor: In wine, lactic acid bacterium producing a spectrum of end products (CO_2, acetate, lactate, ethanol) from the fermentative metabolism of carbohydrates; alternate term for heterolactic the distinction being that heterofermentative specifically refers to fermentative, not oxidative, metabolism; strict heterofermentors convert glucose to CO_2, acetate, lactate, ethanol while facultative heterofermentors convert glucose to 2 moles of lactate, but ferment pentoses producing acetate and lactate

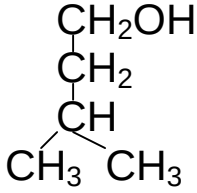
Heterolactic: In lactic acid bacteria, refers to those species and strains that produce a mixture of end products from sugar metabolism: CO_2, acetate, lactate, ethanol; *Oenococcus oeni* is heterolactic

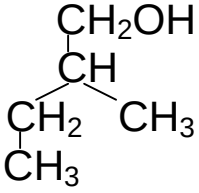
Heterothallic: Not self fertile; having two or more morphologically similar haploid phases or types of which individuals from the same type are mutually sterile but individuals from different types (sexes) are cross-fertile

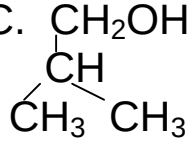
Hexose: General term for a sugar containing six carbon atoms

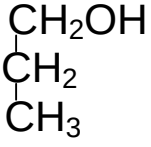
Higher Alcohol: Compound with greater than two carbons; also known as fusel oils; formed by yeast from the degradation of amino acids: deamination, followed by decarboxylation, followed by reduction of the aldehyde formed to an alcohol; principle higher alcohols found in wine:

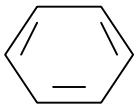
A. 3-methyl butanol (isoamyl alcohol) formed from leucine
B. 2-methyl butanol (active amyl alcohol) formed from isoleucine
C. 2-methyl propanol (isobutyl alcohol) formed from valine
D. 1-propanol (*n*-propyl alcohol) formed from threonine
E. phenethyl alcohol from phenethylalanine
F. tryptophol from tryptophan
G. tyrosol from tyrosine

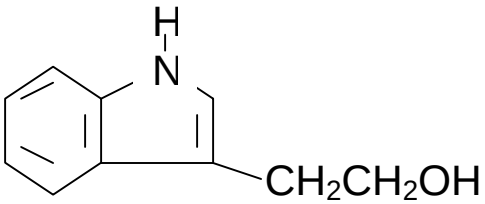
A. 

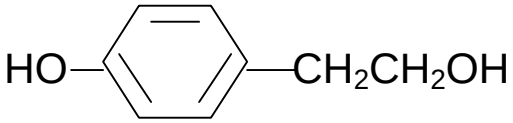
B. 

C. 

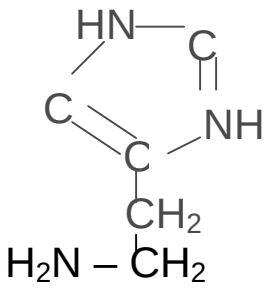
D. 

E.  - CH_2CH_2OH

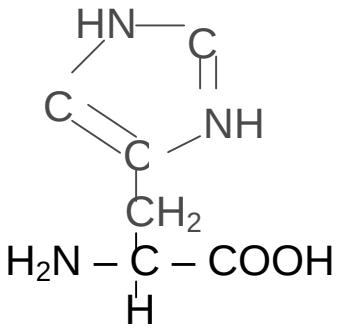
F. 

G. 

Histamine: A biogenic amine produced from the decarboxylation of histidine



Histidine: A basic amino acid; 3 letter code: His; 1 letter code: H; mw: 155.16; pKa: 1.82; 6.0 (imidazole); 9.17; pI: 7.58



Histone: Proteins associated with DNA in chromosomes; involved in packaging and regulation of gene expression

Homofermentor: In lactic acid bacteria, species producing only lactic acid, unable to metabolize pentoses

Homolactic: Term used for lactic acid bacteria that are capable of only producing 2 mole of lactate per mole of glucose consumed

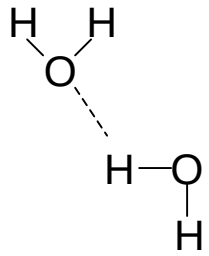
Homothallic: Self-fertile; having a haploid phase that produces two kinds of gametes capable of fusing to form a zygote (diploid)

HPLC: High Performance Liquid Chromatography; a chromatographic technique for the separation and analysis of non-volatile molecules using a liquid as mobile phase

HTST: High Temperature Short Time, refers to pasteurization techniques; used in the wine industry to inactivate enzymes such as mold laccases and in the process of thermovinification

Hydrogen: Element of the periodic table with an atomic number of 1 and an atomic mass of 1.008

Hydrogen Bond: Electrostatic interaction between a molecule with a partial negative charge and one with a partial positive charge; for example between the H of one molecule of water and the O of another

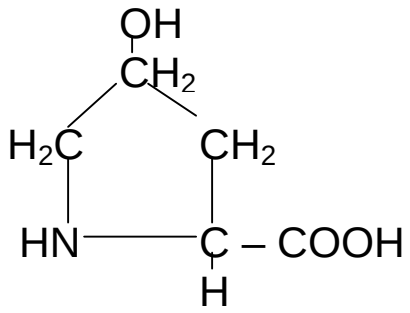


Hydrogen Sulfide: Volatile sulfur compound formed from the reduction of sulfate (SO_4^{-2}) by yeast or from the degradation of sulfur containing amino acids methionine and cysteine; also formed from the chemical reduction of inorganic sulfur used in the vineyard; characteristic rotten egg aroma

Hydrolysis: Chemical process of decomposition involving the splitting of a bond and the addition of the hydrogen cation and the hydroxide anion of water

Hydrometry: Measurement of specific gravity; based on the principle that a body will displace an amount of liquid equal to its own weight; used in wine production to monitor the progress of a fermentation

Hydroxyproline: Derivative of proline found in mature proteins (i.e. collagens) produced from proline residues in protein via the action of proplylhydroxylase; capable of forming hydrogen bonds and therefore of stabilizing protein structure; found as a hydrolysis product of proteins; designation: HyPro



Hypha: plural **hyphae:** One of the threads that make up the mycelium of a fungus, increase by apical growth, and are bi or multinucleate or transversely septate

Imperfect Yeast: Taxonomic term meaning that no sexual spores or sexual cycle has been observed in the isolate

Inert Gas: Non-reactive gaseous element or molecule (carbon dioxide, nitrogen, argon) used in wine production to displace air or oxygen from the surface of a wine

Inoculum: In microbiology refers to the culture, preparation or packet of live microorganisms added to a medium or substrate with the intent of the organisms then growing or metabolizing the substrate

Inositol: Six carbon sugar alcohol (hexitol) $CH_2OH(CHOH)_4CH_2OH$ occurring in nature in cyclic form; a polar head group attached to fatty acids in phospholipids; can be multiply phosphorylated (phosphatidylinositol); in phohsphorylated form an important signaling molecule in eukaryotes; an important nutrient for many wine strains as spontaneous mutants no longer able to synthesize this compound have been isolated from wine strains of *Saccharomyces*

Integrity Test: Test of membrane cartridge filter matrices to determine if filter unit has maintained exclusion limit, that is, does not contain any cracks, breaks or holes in the matrix that would allow material to pass through unimpeded; also called bubble point test

Internal Standard: In chemical analyses requiring preparation of a sample it is frequently important to add a known concentration of a known compound at the beginning of the sample preparation procedure as a control for loss of analyte during the processing. The compound added is generally chemically similar to the analyte, but not present in the sample to be analyzed; internal standards can also be used to calibrate readings against a known concentration

Ion: An element or molecule that is not electronically balanced, that is, with an imbalance between the number of electrons and protons, carrying either a net negative or net positive charge, respectively

Ion Exchange: The process of swapping one ion for another; in practice, ion exchange resins allow substitution of the ionic species on the resin by one in the solution (wine or juice), thereby replacing that ion of the wine or juice with the ion from the resin; example: reduction in acidity by the exchange of hydroxyl ions from the resin for acid anions in the wine

Ion Selective Electrode: General term for an electrode allowing the potentiometric detection of a specific ion

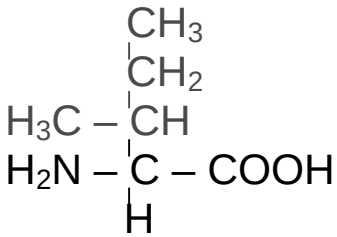
Iron: A metallic element, symbol Fe, with an atomic number of 26 and an atomic mass of 55.85

Isinglass: A protein fining agent derived from fish air bladders; a collagen (protein capable of forming a triple helix)

Isobutyl Alcohol: A higher alcohol (see structure under “higher alcohol”)

Isoelectric Point (pI): The pH at which an ion or molecule is electrochemically neutral, that is, will no longer migrate in an electric field; At pH values above the isoelectric point the molecule carries a negative charge; at pH values below the pI, the molecule carries a positive charge; proteins at wine pH are generally at a pH value below the pI and therefore net positively charged and capable of being removed by a net negatively charged fining agent such as bentonite

Isoleucine: A non-polar amino acid; 3 letter code: Ile; 1 letter code: I; mw: 131.18; pKa: 2.36; 9.68; pI: 6.02

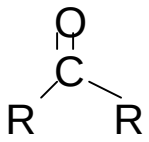


Juice: Term referring to the liquid produced from the crushing of grapes minus the seeds and skins

K_d: See dissociation constant

Keto: The C = O group; keto to enol transition: -C-C=O → -C =C –OH

Ketone: A compound containing a keto group:



Killer Yeast: Term for a yeast strain capable of producing killer factor, a small peptide leading to the death and lysis of sensitive strains

***Kloeckera*:** Genus of yeast found in wine, principally *K. apiculata*; an imperfect yeast: having no known sexual cycle

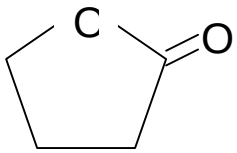
Laccase: Phenol oxidase produced by *B. cinerea* and other molds; resistant to sulfur dioxide (SO_2); can be inactivated by HTST treatments

Lactic Acid/Lactate: Organic acid universally present in prokaryotes and eukaryotes; both intermediate and an end product of metabolism; $CH_3CHOHCOOH$

Lactic Acid Bacteria: General term for bacteria producing lactic acid as an end product of fermentation

***Lactobacillus*:** Genus of lactic acid bacteria; contains both hetero and homofermentative organisms; some are important spoilage organisms of wine

Lactone: Components of wine aroma formed from the internal esterification of molecules containing a hydroxyl and carboxylic acid group; also extracted from barrel wood or produced by yeast

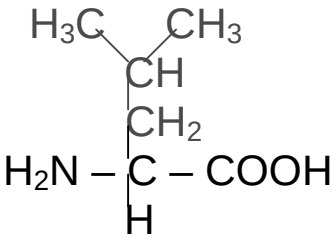


γ-Butyrolactone

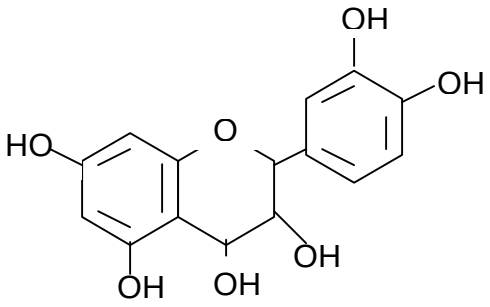
Lane-Eynon: Method for the measurement of reducing sugar based on titration with alkaline copper sulfate

Lees: General term for the residue settling to the bottom of a tank; can be derived from the grapes (grape lees) or following microbial activity (yeast lees)

Leucine: A non-polar amino acid; 3 letter code: Leu; 1 letter code: L; mw: 131.18; pKa: 2.36; 9.60; pI: 5.98



Leucoanthocyanin: Colorless anthocyanin; containing hydroxyl groups at the 3 and 4 position of the C or bridge ring of the flavanoid



***Leuconostoc*:** Genus of lactic acid bacteria; the principle agent of the malolactic fermentation in wine was formerly known as *Leuconostoc oenus*, now called *Oenococcus oeni*

Levorotary: An optically active substance is one that rotates the plane of polarized light; if that rotation is to the left or counterclockwise the substance is levorotary

Light Struck: Term describing wine that has been exposed to light which catalyzes certain reactions in the wine; light struck wines are described as plastic, wet dog and corn nuts; a particular problem for sparkling wines as the carbon dioxide enhances perception of flavorants in the wine

Lignin: Polymer of phenolic residues found in cell walls of plants conferring strength and rigidity; particularly in woody plants

Limonene: Widely distributed terpene hydrocarbon that occurs in essential oils (as of oranges or lemons) and has a lemon odor; can be found in wines

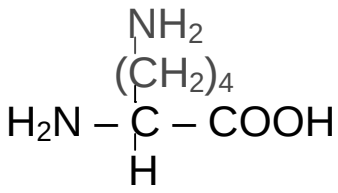
Linalool: Terpene alcohol (terpenol); fragrant liquid alcohol that occurs both free and in the form of esters in many essential oils and is used in perfumes, soaps, and flavoring materials; describes as citrus floral

Linear Regression Analysis: Determination of the relationship between two variables, such as amount of protein and absorbance; straight lines follow the formula y = mx + b where y is the dependent variable, x the independent variable, m the slope of the line and b the y intercept; the slope and intercept can be calculated from the experimental data of known concentrations, then knowing the absorbance of an unknown allows calculation of the protein concentration; a correlation coefficient for the line can be calculated which describes the goodness of fit of the relationship between the two variables

Lipid: Generally, a term for compounds that are insoluble in water and extracted from cells by organic solvents; specifically refers to fats which are comprised of carboxylic acid; fats derived from glycerol are called triglycerides; predominant in membrane bilayers; function as an energy reserve in animals

Lipoprotein: Protein covalently attached to a lipid moiety

Lysine: A basic amino acid; 3 letter code: Lys; 1 letter code: K; mw: 182.70 (LysHCl); pKa: 2.18; 8.95 (α amino); 10.53 (ε amino); pI: 9.74



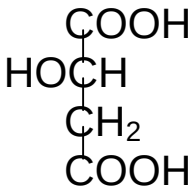
Lysozyme: Small enzyme found in animal secretions (i.e., tears, saliva) that cleaves the peptidoglycan layer found in gram positive bacteria leading to lysis of the target cells; effective against the gram positive lactic acid bacteria in wine

Macerate: To cause to become soft or separated into constituent elements by or as if by steeping in fluid; to soften and wear away especially as a result of being wetted or steeped

Macronutrient: Nutrient that is needed as a building block for new cell synthesis; refers to the source of cellular carbon, nitrogen, sulfate and phosphate

Maillard Reaction: Condensation reaction between sugars and amino acids (or proteins) leading to a brown color

Malic Acid/Malate: Dicarboxylic acid occurring in two optically isomeric forms; especially the levorotatory isomer that is found in various fruits (as apples) and is formed as an intermediate in the Krebs cycle; Malate: a salt or ester of malic acid

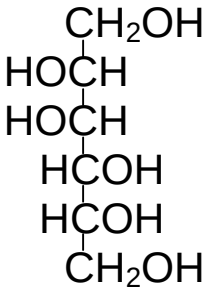


Malolactic Fermentation: Relating to or involved in the bacterial conversion of malic acid to lactic acid in wine

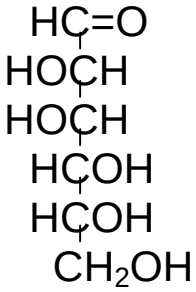
Malvidin: An anthocyanin of grapes (see anthocyanin)

Manganese: An element of the periodic table with an atomic number of 12 and an atomic mass of 24.305; a micronutrient required by prokaryotes and eukaryotes

Mannitol: A sugar alcohol that can be converted to an off character by members of the lactic acid bacteria; reduction product of fructose via a reaction catalyzed by mannitol dehydrogenase



Mannose: A hexose found in grapes and other plant material; can be catabolized by *Saccharomyces*, other yeasts and bacteria



Mannoprotein: Component of yeast cell walls; protein covalently linked to polymers of mannose

Michaelis-Menton Equation: Defines the quantitative relationship between substrate concentration and enzyme reaction rate; a plot of reaction rate, v, versus substrate concentration [S] can be used to calculate both the K_m (Michaelis-Menton constant) and V_{max}, the maximum reaction rate possible under the conditions of the assay

$$V = \frac{V_{max}[S]}{K_m + [S]}$$

If $v = ½ V_{max}$, $K_m = [S]$; thus the K_m is defined as the substrate concentration at which the rate of reaction is half of the maximal value

Media: singular **medium:** In microbiology, the term for the solution used to grow microorganisms; may be rich (excessive nutritional content); minimal (mixture of simple salts meeting growth requirements); defined (exact composition of the mixture known) or complex (exact composition of the mixture unknown due to use of complex components such as apple juice for the cultivation of lactic acid bacteria)

Mercapatan: Compound containing a terminal SH group; ethyl mercaptan: CH_3CH_2SH; methyl mercaptan: CH_3SH

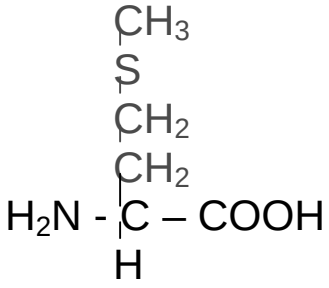
Mesocarp: the middle layer of a pericarp

Metabolism: The biochemical changes in living cells by which energy is provided for vital processes and activities and new material is assimilated; the sum of anabolic and catabolic reactions of a cell

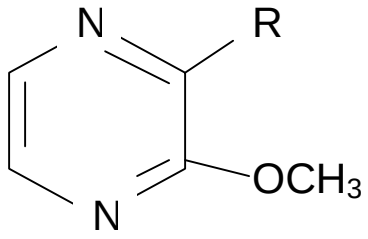
Metal: Elements capable of conducting both heat and an electric current; malleable; elements having a metallic luster (reflecting light)

Methanol: Methyl alcohol; source in wine is the hydrolysis of methylated pectins; BATF limit in wine is 1 g/L; CH_3OH

Methionine: A non-polar sulfur-containing amino acid; 3 letter code: Met; 1 letter code: M; mw: 149.21; pKa: 2,28; 9.21; pI: 5.75



Methoxypyrazine: A class of compounds found in wine responsible for the vegetative aroma, particularly bell or green pepper; originate in the fruit and levels are affected by vineyard practices



Methyl: Derived from methane; having a CH_3 group

Methyl Mercaptan: Degradation product of methionine; responsible for a cabbage character; CH_3SH

***Metschnikowia*:** Genus of yeast found on the surface of grape, specifically one species: M. pulcherrima; can be found during fermentation, especially at low temperatures; produces needle shaped ascospores; a perfect yeast

Micronutrient: Essential growth requirements needed in small amounts; cofactors; minerals and vitamins are micronutrients; with the exception of Mg and K, which are needed in the mM range, most micronutrients are needed in the μM or sub μM range

Microoxidation: Somewhat of a misnomer for the process of exposing wine to small amounts of air (oxygen) on the assumption that that will lead to formation of a low concentration of oxidation products; more correctly termed microaeration

Mineral: Naturally occurring homogeneous element or molecule; originating from abiological processes of nature; subset of these compounds are required as micronutrients

Mitochondria: Subcellular organelle; site of respiration; the energy factories of the cell. ATP production in the mitochondria is catalyzed by enzyme complexes that are embedded in the inner mitochondrial membranes: the electron transport chain

ML34: Name of a commercially available strain of *O. oeni*

MOG: Acronym for Material Other than Grape that can be present during harvest

Mold: General term referring to members of the fungi that exist in the vegetative state primarily in the mycellial as opposed to yeast form

Molarity: Concentration expressed as the number of moles of solute per liter of

solution; the number of moles is determined by dividing the number of grams of a solute by its atomic, molecular or formula weight and the volume

$$\text{Molarity (M)} = \frac{\text{g solute}}{\text{MW of solute (g) x Liters of solution}}$$

Mole: Unit equivalent to the atomic, molecular or formula weight in grams; one mole of carbon is 12g; one mole of carbon dioxide is 44 g (1 x C (12) + 2 x O (16))

Molecular Weight: Relative mass of a molecule as compared to an atom of carbon, C^{12}, calculated from the chemical formula

Monoecious:: Self-fertile; in plants, means that a single individual will have both pistillate and staminate flowers; male and female sex organs in the same individual; hermaphroditic

Monosaccharide: Term meaning a single sugar or simple carbohydrate; can be aldehydes and ketones comprised of 3, 4, 5 or 6 carbons with the general structure $(CH_2O)_n$; xylose, arabinose, glucose, fructose, galactose, mannose are all monosaccharides

Monoterpene: Term for a $C_{10}H_{16}$ molecule derived from the condensation of two isoprene units; important grape aroma components; see terpene

Montmorillonite: Term for bentonite derived from the French town at which it was first discovered

Mousey Odor: An off character found in wine reminiscent of a used mouse cage; formed by lactic acid bacteria or *Brettanomyces*/*Dekkera* ; character arises from the oxidation of lysine

MSDS: Material Safety Data Sheet; for all chemicals, a document that describes the exposure limits, safe handling and storage procedures; toxicological properties of the agent and the symptoms of exposure; recommended first aid treatment an important information to give to medical personnel; suggested procedures for the safe use of the chemical and necessary precautions in its use; potential hazard (fire, explosion) data; any chemical reactivity that may pose a storage or safety hazard; procedures for clean up of a spill or leak; **SHOULD BE CONSULTED AND READ BEFORE THE CHEMICAL AGENT IS USED BY A WORKER**

Must: Term describing the mixture of grape juice, skins and seeds produced from grapes by the process of crushing

MWCO: Molecular Weight Cut-Off; term used to describe the porosity of filtration membranes

Mycelium: plural **–lia:** The mass of interwoven filamentous hyphae formed by fungi; can be invasive and submerged in another body (as of soil or organic matter or the tissues of a host); also: a similar mass of filaments formed by some bacteria

NAD/NADH: Nicotinamide adenine dinucleotide; along with NADP an important coenzyme in oxidation reduction reactions; formally transfers a hydride ion (H nucleus with 2 electrons)

NADP/NADPH: Nicotinamide adenine dinucleotide phosphate; along with NAD an important coenzyme in oxidation reduction reactions; formally transfers a hydride ion (H nucleus with 2 electrons)

Native Flora: The microorganisms occurring naturally on the surface of the grape; native flora fermentations are those that are not deliberately inoculated; also called indigenous flora

Nephylometry/Nephylometer: Process or device measuring the degree of light scattering; a consequence of the concentration and size of suspended particles; similar in operation to the lumitron and Klett meter; a simple light source (not monochromatic) is used and the amount of light penetrating the cell measured; used principally to assess microbial mass and to assess haze formation in wine

Nitrate: A form of inorganic nitrogen, NO_3^-; serves as a nitrogen source for many microbes (bacteria and yeast) and for plants; not used by *Saccharomyces*

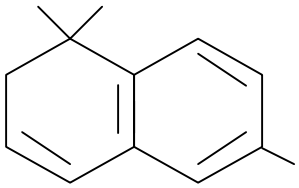
Nitrite: A form of inorganic nitrogen, NO_2^-; serves as a nitrogen source for many microbes (bacteria and yeast) and for plants; not used by *Saccharomyces*

Nitrogen: Element of the periodic table with an atomic number of 7 and an atomic weight of 14.01; N_2 is the common form existing as a gas; N_2 is used in wine production along with argon and carbon dioxide to displace air (oxygen) from the surface of wines, juices and musts, and for anaerobic mixing of the contents of a tank

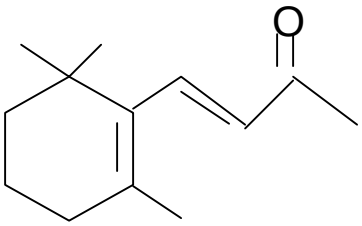
Noble Rot: Used to describe the process of infection of clusters by *B. cinerea*

Non-Flavonoid: General term for phenolic compounds in wine not possessing the features of flavonoid molecules

Norisoprenoid: In wine, C13 compounds derived from the breakdown of carotenoids (tetraterpenes found in plants); have important aromatic properties



Trimethyldihydronaphthalene (TDN)



β - Ionone

Normality: Unit of concentration expressing the number of equivalents (protons or electrons) of solute per liter of solution; important in titrations; a one normal (1N) solution contains one equivalent weight per liter of one substance that reacts exactly with one equivalent of another; defines a 1:1 reaction ratio, not a 1:1 molar ratio; for example, in acid base titrations H_2SO_4 contains two equivalents of hydrogen, therefore the normality is the molarity divided by 2; see equivalent weight

Nutrient: A compound required by an organism to produce new cells or to maintain viability

Oak Chip: Term for pieces of oak wood used in place of oak barrel aging to impart an oak character to wine; available in different toasting levels and in different sizes

Octanoic Acid: Saturated short chain fatty acid containing 8 carbon molecules; can be produced by yeast and other microbes; inhibitory to Saccharomyces in high concentration

$$CH_3\text{-}(CH_2)_6COOH$$

Oechsle: Density scale amplifying the contribution of solute over that of water

***Oenococcus oeni*:** Lactic acid bacterium, the principle agent of the malolactic fermentation; formerly known as *Leuconostoc oenus*

Organic Acid: General term for molecules comprised of C, H and O and containing a carboxyl group: $CH_3(CHR)_nCOOH$

Organoleptic: Refers to the qualities (taste, color, odor, fee)l, detectable by human senses of a substance; alternately, involving use of the sense organs as in the evaluation of foods

Osmosis: Movement of a solvent such as water through a semipermeable membrane, such as the plasma membrane of a cell, for example, in living cells the movement of water across a membrane to a solution of higher salt density; the plasma membrane is freely permeable to water but not to proteins; if cells are placed in a water solution, the activity of the water on the outside will be less than the activity of water on the inside of the cell because of the differential presence of protein and other macromolecules; consequently water will flow into the cell via the process of osmosis until equilibrium is reached

Overfining: The addition of an excess amount of a fining agent such that it has a noticeable effect on the quality of the wine

Oxidant: Oxidizing agent; compound possessing a strong affinity for electrons thereby causing another molecule to lose electrons and become oxidized; the oxidant is reduced in the process

Oxidation: Involves an increase in oxidation number of a molecule and an apparent loss of electrons by an atom, group of atoms or ion; opposite of reduction

Oxygen: An element of the periodic table with an atomic number of 8 and an atomic weight of 16.00; present in the environment in a diatomic form, O_2; terminal electron acceptor for respiration

Oxygenation: Insertion of oxygen atoms derived from molecular oxygen, O_2, into a substrate molecule; generally catalyzed by enzymes (not to be confused with aeration and oxidation!)

Ozone: O_3; highly reactive triatomic form of oxygen able to cleave carbon=carbon double bonds; lethal to cells; sterilant used in the treatment of bottling lines and barrels in wineries

Pantothenate: Vitamin; precursor of Coenzyme A

PCR: Polymerase Chain Reaction; a technique using a temperature tolerant DNA polymerase to synthesize large quantities of a specific DNA fragment; RT-PCR: reverse transcriptase PCR: technique for the analysis of RNA via PCR by first converting the RNA to complimentary or cDNA; fragments can then be separated and analyzed by gel electrophoresis; PCR can be used to detect specific DNA in a mixture such as pathogens in a grapevine from a sample of grape material; a specific yeast strain in a fermentation with a mixture of yeast species

Pectin: Polysaccharide found in plant cell walls comprised of a backbone of galacturonic acid with rhamnose residues to which side chains are attached; along with cellulose and hemicellulose, a major constituent of plant cell walls

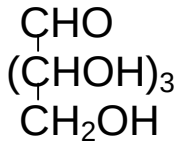
Pectinase: General term for an enzyme or an enzyme preparation capable of the degradation or hydrolysis of pectin polymers; used in juice to reduce viscosity and facilitate settling and pressing; commercial preparations are a mixture of three different pectinase activities: pectin methyl esterase; pectin lyase; polygalacturonase

Pectin Lyase: Cleaves the glycosidic linkages in the galacturonic acid backbone of pectin

Pedicel: Small stem attaching the grape berry to the rachis

Pediococcus: Genus of lactic acid bacteria found in wine; may be important causative agents of spoilage

Pentose: A five carbon sugar molecule; not utilized by *Saccharomyces* or by some members of the lactic acid bacteria, but can be used by other yeasts and lactics and by other bacteria as carbon and energy sources; common pentoses of plants: xylose, arabinose, ribose



Peptide: Any of various amides derived from two or more amino acids by combination of the amino group of one acid with the carboxyl group of another (called a peptide bond); generally refers to a short (less than ten amino acid residues) polypeptide chain

Peptidoglycan: A component of bacterial cell walls comprised of a linear polysaccharide cross-linked via peptide molecules

Perfect Yeast: Term for yeast species for which a sexual cycle (formation of sexual spores) has been observed; used in the taxonomic classification of yeasts; see imperfect yeast

Pericarp: The ripened and variously modified walls of a plant ovary

Periodic Table of the Elements: Table of Elements; Table of Atomic Weights

Perlite: Filtration matrix for wine derived from volcanic rock consisting of aluminum silicate particles; similar function to diatomaceous earth in wine processing: a rough filtration

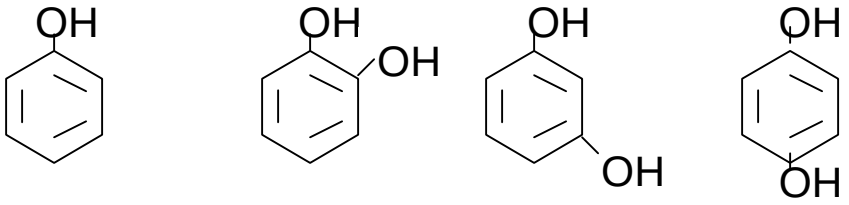
Peroxisome: A membrane bound organelle found in eukaryotes that is the site of oxidative reactions as in the oxidative degradation of fatty acids; site of localization of catalase and peroxidases

Petiole: The slender stem that supports the blade of a leaf; in grapes, petiole analysis is used to determine the nutritional status of the vine

Petunidin: An anthocyanin pigment found in grapes

pH: The negative log of the hydrogen ion concentration (more correctly the hydrogen ion *activity*) of a solution; a measure of acidity and alkalinity expressed on a scale of 1 to 14 with 1 representing an acidic solution, 14 representing a basic solution and 7 representing neutrality

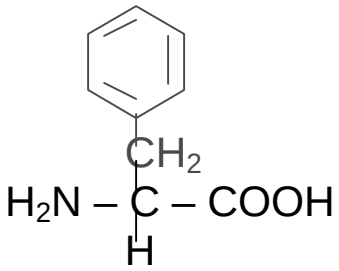
Phenol: Benzene ring carrying a hydroxyl group; may be mono-, diphenol, triphenol or polyphenolic depending upon the number of hydroxyl groups attached to the ring; hydroxyl derivatives of aromatic hydrocarbons



Ortho (*o*) Meta (*m*) Diphenol Para (*p*)

Phenolic: Relating to, or having the characteristics of a phenol; benzene ring with a hydroxyl group; containing or derived from a phenol

Phenylalanine: A non-polar aromatic amino acid; 3 letter code: Phe; 1 letter code: F; mw: 165.19; pKa: 1.83; 9.13; pI: 5.98



Phloem: Along with the xylem, comprises the vascular system of plants involved in the transport or translocation of water, sugar and other nutrients throughout the plant; the phloem specifically transfers sugars produced by the process of photosynthesis and other organic molecules throughout the plant

Phosphate: $PO_4^{3-}/HPO_4^{=}$; Common form of phosphorous found in all living systems

Phospholipid: Principle component of cell membranes; refers to a group of molecules possessing the properties of lipids but that contain a phosphate group; consist of two fatty acid chains linked to two hydroxyls of a glycerol molecule with the third hydroxyl linked to a phosphate group, the phosphate group is then linked to one of four possible terminal or "head" groups: ethanolamine (phosphatidylethanolamine); choline (phosphatidylcholine); serine (phosphatidylserine); instill (phosphatidyl instill); Sphingomyelin is also a phospholipid but is based upon linkage of the fatty acid groups to the amino group and carboxyl groups of serine with the phosphate linked to the hydroxyl group of the serine, the head group is choline; glycolipids are similar to sphingomyelin except that the serine is linked to a glucose molecule instead of phospho-choline

Phosphorus: Element of the periodic table with an atomic number of 15 and an atomic mass of 30.97

Phosphorylation: The process of addition of a phosphate group to a compound either via direct relation with inorganic phosphate or via transfer catalyzed enzymatically by proteins known as kinases

Photosynthesis: In plants and bacteria, the conversion of energy from light to chemical energy in the form of organic carbon molecules; in plants, occurs in the chloroplasts found in green tissues

Phylloxera: Aphid like insect feeding on grape roots causing damage to the plant and eventual death of the vine; *Daktulosphaira vitifoliae* FITCH

Phytoalexin: General term for the collection of small molecule, non-proteinaceous antifungal agents produced by a plant in response to attack by a pathogen

Pichia: Genus of yeast found on grapes, in musts, juices and wines and in wineries; can be the causative agents of wine spoilage

Pinking: Refers to the appearance of a reddish tint in white wines; thought to be an oxidation product, but the exact mechanism is unknown; has been proposed to be the oxidation product of flavenes, but this has not been unequivocally demonstrated

pKa: Negative log of the dissociation constant (K_a) of an acid species; See equilibrium constant

Plasma Membrane: The lipid bilayer surrounding the cytoplasm of a cell and beneath the cell wall; the principle permeability barrier of the cell; comprised of phospholipids, glycolipids, sterols and protein

Polypeptide: Literally, a polymer of peptide bonds and therefore of amino acids

Polyphenol: A phenol molecule containing more than one hydroxyl group; see phenol

Polyphenol Oxidase (PPO): Name of the principle tyrosinase found in grapes that is responsible for oxidation of phenolic compounds; present in different levels in response to environmental conditions; wide variation in levels across grape varietals

Polysaccharide: General term for a polymer of sugar (hexose, pentose or mixture of the two) units; function structurally as in the case of cellulose and glucan or as a storage reserve of carbohydrate as in the case of glycogen; if only a few sugar molecules are linked, the structure is called an oligosaccharide; polysaccharide implies the order of thousands of sugar units are linked in the structure

Polyvinylpolypyrolidone (PVPP): Fining agent used for the removal of phenolic compounds in juices and wines; specifically to reduce pinking potential; polymer of polyvinylpyrolidone (PVP)

Polymerization: Chemical reaction by which two or more molecules combine to form larger molecules that contain repeating units

Pomace: Term for the skin a seed residue remaining after the pressing of musts or wines (red wines following fermentation on the skins)

Potassium: Element of the periodic table with the designation “K” and an atomic number of19 and an atomic mass of 39.1

ppb: Parts per billion; μg/L (10^{-6} g in 10^{3} mL)

ppm: Parts per million; mg/L (10^{-3} g in 10^{3} mL)

Precipitate: Term for the insoluble lattice formed from the reaction of two elements, compounds or molecules

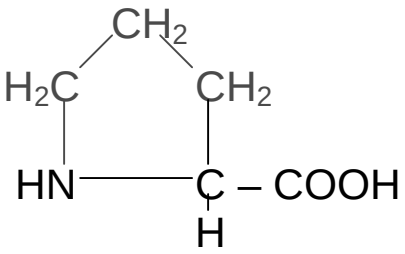
Precision: The agreement between replicate measures of the same quantity; standard deviation is a measure of precision

Proanthocyanidin: Family of polymers of phenolic compounds containing both anthocyanin and flavan-3-ols; important in wine astringency

Procyanidin: Class of polymers produced from flavan-3-ols between 2 and 8 units in size

Prokaryote/Procaryote: An organism, usually unicellular, that does not possess a membrane bound nucleus; bacteria are prokaryotes

Proline: A non-polar imino acid possessing a cyclic structure; 3 letter code: Pro; 1 letter code: P; mw: 115.13; pKa: 1.99; 10.6; pI: 6.10



Protease: An enzyme capable of degradation of proteins; classified according to the most prominent functional group (as serine or cysteine) at the active site; called also **proteinase**

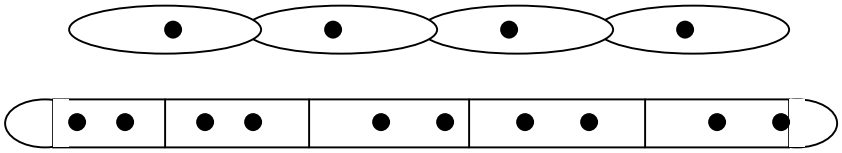
Protein: A functional polypeptide; may be structural or catalytic; involved in translocation or storage of substrates or transmission of signals or information

Proton: Term for a hydrogen ion, H^+; can also be considered a growth factor for yeast since they couple proton movements to the uptake of substrates

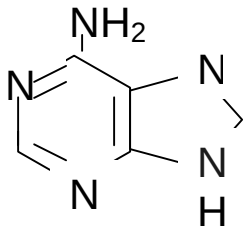
Protonate: To add a proton to

PRP: refers to two different classes of proteins, most commonly in wine means Pathogen Response Protein, the proteins produced by plants in response to attack by a pathogenic agent; an alternate meaning is Proline Rich Proteins, which happen to be important proteins in the plant response to pathogens

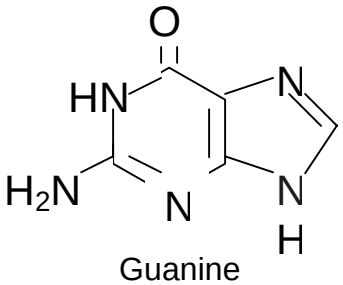
Pseudohyphae: Refers to a hyphal-like structure formed by some yeast species that is in reality an organized chain of individual cells; can be distinguished from true hyphae by the indentations of the septate between cells



Purine: Constituent of DNA and RNA; the moiety or base linked to phosphorylated sugar (2-deoxyribose for DNA; ribose for RNA)via the N in the 9 position of the 5 membered ring to form nucleotides; there are two purines: adenine and guanine



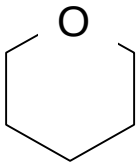
Adenine



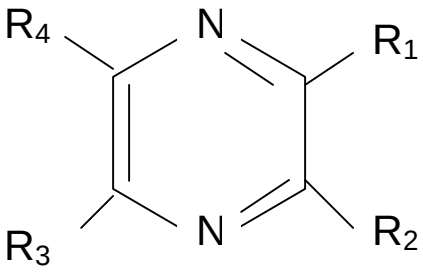
Guanine

Adenine forms three hydrogen bonds with thymine and guanine forms two hydrogen bonds with cytosine in the pairing of bases in DNA

Pyran: An oxygen-containing six-member ring; containing 5 carbons in addition to the oxygen

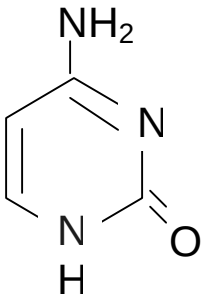


Pyrazine: Class of 6 member heterocyclic compounds containing 2 N and 4 C atoms; important contributors to the aroma of wines, especially Cabernet Sauvignon

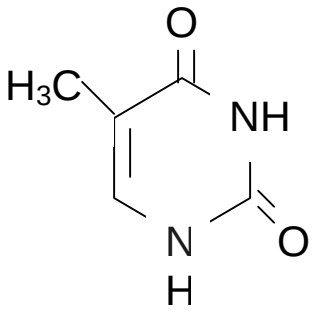


Pyridoxal Phosphate: Coenzyme involved in amino acid metabolism: racemizations and transaminations

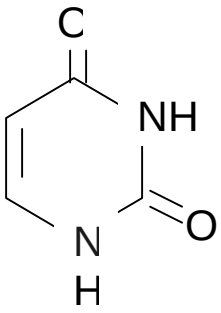
Pyrimidine: Constituent of DNA and RNA; the moiety or base linked to phosphorylated sugar (2-deoxyribose for DNA; ribose for RNA) via the N in the 3 position of the 6 membered ring to form nucleotides; there are three purines: thymine and cytosine are found in DNA; uracil and cytosine in RNA



Cytosine

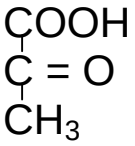


Thymine



Uracil

Pyruvic Acid/Pyruvate: End product of glycolysis; universally found in eukaryotes and prokaryotes; entry point for the citric acid cycle; decarboxylated to acetaldehyde in fermentation by yeast or reduced to lactic acid in fermentation by members of the lactic acid bacteria; 3 carbon carboxylic acid



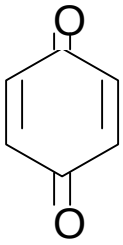
QC: An abbreviation meaning quality control

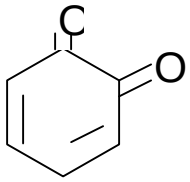
Qualitative Analysis: Used to detect the presence or absence of a compound; paper chromatography for the detection of the malolactic fermentation is qualitative: the presence or absence of specific acids can be assessed

Quantitative Analysis: Used to determine the concentration of a unknown substance, not just its presence or absence

***Quercus*:** The genus name for the various species of oak.

Quinone: Cyclic diketone derivatives of dihydro-benzene; typically colored compounds





Quinonoid or Quinoid: Resembling a quinone especially in having a benzene nucleus containing two double bonds within the nucleus

Rachis: Stem of a grape cluster

Reagent: General term for a chemical or compound used in an assay or buffer

Rebelein: Method for the analysis of reducing sugar based on the reaction of free Cu^{++} with iodide producing I_2 followed by titration with thiosulfate

Reducing Agent: Compound readily giving up electrons thereby causing other substrates to gain electrons and become reduced; the reducing agent is oxidized in the process

Reducing Sugar: Sugar containing functional groups capable of losing electrons and thereby becoming oxidized; capable of reducing an oxidizing agent such as Cu^{++}, Ag^{+}, ferricyanide; glucose, fructose and many pentoses are reducing sugars

Reduction: Opposite of oxidation; the process of gaining of electrons

Refractometry: The passage of light from one medium to another of a differing optical density causes the light to bend or change direction, called refraction; refractometers measure the change in the angle of refraction; the change in the angle is proportional to the concentration of the sample being analyzed; used to estimate sugar concentration in grape samples, juices and musts

Relative Standard Deviation (Coefficient of Variation; CV%): The standard deviation divided by the mean:

$$CV\% = \left(\frac{S.\,D.}{\overline{X}} \right) 100\%$$

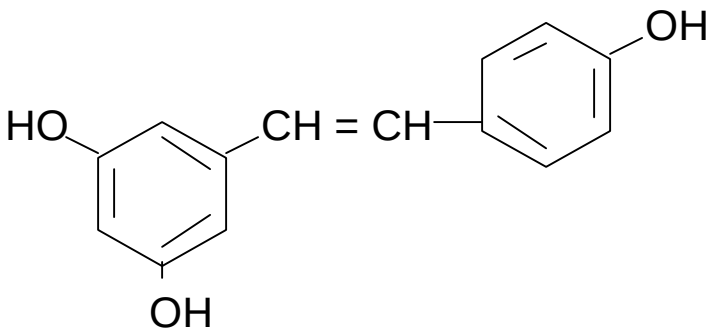
Repeatability: Measure of the precision of data obtained by a single researcher

Reproducibility: The precision of a measurement or observation when assayed or taken from independent experiments, by different experimenters, using different equipment or simply taken at different times

Residual Sugar: Term for the level of reducing sugar, glucose and fructose, left in the wine at the end of fermentation; if the wine is “dry” it has less than 2 g/L combined of glucose and fructose

Resveratrol: A phytoalexin with antioxidant properties that has been shown to protect against the oxidation of LDL (low density lipoprotein) thereby reducing the formation of

plaque in arteries



Trans –3,5,4'-trihydroxystilbene

Retentate: In cross-flow filtration, the liquid component that is not passed through the filter matrix

Reverse Osmosis: Term for the extraction of water or other small molecules from a solution of higher density due to the application of pressure; MWCO of the membranes are on the order of 10 to 100 Daltons; used for the removal of water in the formation of grape juice concentrate; for the removal of ethanol and the dealcoholization of wine; and for the removal of acetic acid from wine

RFLP: Restriction Fragment Length Polymorphism, a technique used to identify genetic differences between members of the same species; restriction endonucleases are enzymes that cleave DNA in a sequence-specific manner, for example recognizing a specific 6 base pair palindrome, alteration via a mutational base pair change of the site renders it uncleavable by the enzyme meaning that the organism missing the restriction site will have a larger piece of DNA following digestion of the DNA with the enzyme than the other organism; the differences in size can be detected by gel electrophoresis; used to compare two organisms to determine the amount of relatedness as well as to search for genetic differences in a population; the more diverse the two organisms the greater the number of polymorphisms revealed by RFLP analysis

Ripper Method: Method for the analysis of sulfur dioxide, SO_2; Uses standardized solution of iodine to titrate free or total SO_2; the reaction is complete when the indicator starch turns blue-black due to the presence of free (unreacted) iodine

RNA: Ribonucleic acid; a key macromolecule in all living cells; several functional forms of RNA exist:

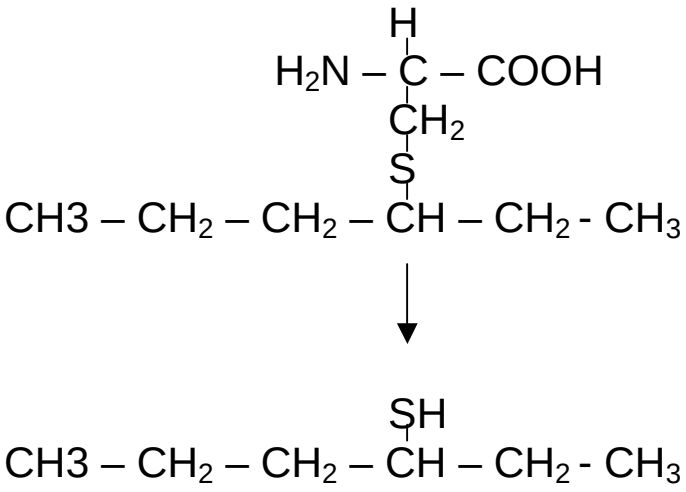
mRNA: messenger RNA that is translated by ribosomes to produce protein
tRNA: transfer RNA used in the synthesis of proteins
rRNA: ribosomal RNA a component of ribosomes
snRNA: small nuclear RNA involved in multiple functions: mRNA processing called splicing; ribosome assembly; etc

***Saccharomyces*:** Genus of yeast that conducts the alcoholic fermentation of grape juice; also involved in beer and bread production; from “sacchar” meaning sugar and “myces” for fungus: sugar-loving fungus; perfect yeast producing ascospores; species associated with fermentation: *S. cerevisiae*; *S. bayanus*; *S. carlsbergensis*.

Sanitizer: Cleaning agent that reduces the number of microorganisms but does not eliminate them completely; common sanitizers are hypochlorites (HOCl), iodophores (I_2), sulfur dioxide (SO_2), and quaternary ammonium salts (QUATS); physical sanitization (hot water or steam) can also be used; ultraviolet light and ozone are also being used as sanitizing agents in some circumstances

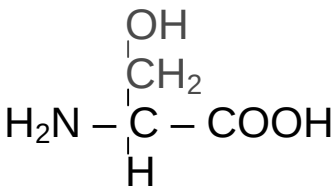
Saturated: May refer to a solution or to a hydrocarbon chain; in the case of a hydrocarbon chain it means that all carbons have the maximal amount of bound hydrogen atoms, there are no double bonds; for solutions, saturated means the concentration of solute is maximal, the concentration achieved when there is undissolved solute present in the solution; a super saturated solution is one where the concentration of solute exceeds that normally found if undissolved solute is present

S-Cysteine Conjugates: Precursor form of volatile thiols important in the flavor of wines, especially Sauvignon blanc; cleaved during fermentation; three principle thiols are generated: 3-mercaptohexanol, 4-methyl-4-mercaptopentan-2-one, and 4-methyl-4-mercaptopentan-2-ol



3-mercaptohexanol

Serine: Polar amino acid containing a hydroxyl group; 3 letter code: Ser; 1 letter code: S; mw: 105.09; pKa: 2.21; 9.15; pI: 5.68



Silica Gel: Fining agent; an aqueous colloidal suspension of silicon oxide; produced by the treatment of sodium silicate with acid; used especially in combination with gelatin for the removal of proteins and tannins; commercial preparations: baykisol, klebsol, kieselsol

Sluggish Fermentation: Also called a slow fermentation, refers to a fermentation progressing at a slower than expected rate; generally at high risk of becoming stuck

Soluble: Capable of being dissolved or dispersed in a liquid solution

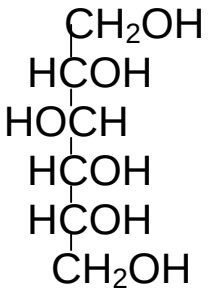
Soluble Solids: Term equivalent to suspended solids

Sorbic Acid/Sorbate: Anitmicrobial agent used in wine; short chain unsaturated fatty acid that is fungistatic;

$$CH_3CH=CH-CH=CHCOOH$$

can lead to the formation of the geranium off odor in wines: 2-ethoxy-3,5-hexadiene

Sorbitol: Sugar alcohol found in wines, especially in botrytized wines



Specific Gravity: The ratio of relative masses of equal volume; density is defined as mass per unit volume; specific gravity is relative density (mass/ unit volume/mass/unit volume); for example, the Brix scale is a specific gravity scale: g sucrose/ 100 g solution

Spectrophotometry: Analytical tool based on determining the light-interacting

properties of an analyte: absorption, fluorescence or scattering, at a specific wavelength of light; can be used to determine the concentration of an analyte; can use UV (ultraviolet) or visible light; concentration can be determined by the comparison of the absorptive properties of an unknown concentration of an analyte to a standard curve equating absorption of known concentrations of the analyte in the same matrix; *Spectometry* is a more general term for analytical methods involving energy in the form of light or electromagnetic radiation

Sporulation: The process of forming of spores; refers to both asexual (no change in ploidy or chromosome number) and sexual spores (meiosis, or a reduction in ploidy (2N → 1N); applied to both yeast and the resting spores of bacteria (*Bacillus* and *Clostridium*)

Standard Curve: In analyses, refers to the plot of the response of known concentrations of a substrate versus the property being analyzed (such as absorbance) so that the concentrations of an unknown sample can be determined from the curve; for example, in protein assays it is common to run a standard curve of the response of differing but known concentrations of BSA versus the absorbance of the sample; important in cases where ambient conditions (temperature, humidity) or subtle differences in sample or buffer composition (heavy metals or other contaminants of the water or chemicals used) impact the readings obtained

Standard Deviation (S.D.): A measure of the variance of a data set; equal to the square root of sum of the square of all of the measurements or observations, x_i, minus the average $\overline{x}$ (the sum of the measurements x_i divided by the total number of measurements) divided by the total number of measurements (N) minus 1:

$$S.D. = \sqrt{\frac{\sum (x_i - \overline{x})^2}{N - 1}}$$

Stave: Term for a plank of oak inserted into a tank to impart oak favor

Sterol: Important component of yeast membranes (see ergosterol); sterols and their derivatives perform a variety of functions in animal cells; synthesized from squaline

Stoichiometry: The quantitative relationship between constituents in a chemical substance or reaction; a stoichiometric reaction implies the consumption of one compound (substrate) with the concomitant appearance of an equimolar amount of another (product)

Stuck Fermentation: Also known as an arrested or incomplete fermentation refers to a fermentation in which sugar consumption has appeared to have ceased; fermentation with a high (> 2 g/L) residual sugar

Substrate: Element, molecule or compound against which an enzyme exerts a catalytic action; alternately refers to macronutrient or medium used for microbial growth

Succinic Acid/Succinate: Central acid of the citric acid cycle; can be found in wines; at high concentration, reminiscent of a brine flavor; produced from α ketoglutarate via formation of succinyl CoA; interconverted with fumarate by succinate dehydrogenase

Sucrose: α- D-Glucopyranosyl β-D-fructofuranoside, a disaccharide sugar comprised of one molecule of glucose and one of fructose that occurs naturally in most plants; the circulating form of sugar in plants produced from the process of photosynthesis

Sugar: General term meaning a sweet crystalline substance; refers generically to carbohydrates, most frequently meaning mono- and disaccharides

Sulfate: $SO_4^{=}$; the most dominant form of sulfur utilizable as a macronutrient by biological systems; must be reduced to sulfide to be incorporated into amino acids

Sulfide: $S^{=}$; anionic species; general term for reduced sulfur; can also refer to a compound containing a sulfide moiety

Sulfite: SO_3^{2-}

Sulfur: Element of the periodic table with an atomic number of 16 and atomic mass of 32.06; inorganic sulfur is used in the vineyard as an antifungal agent; if present in high enough concentration on fruit at the time of harvest, can lead to the formation of the H_2S spoilage character

Sulfur Dioxide: SO_2; an antimicrobial agent that can also function as an antioxidant; generally added to wine at levels on the order of 20 –50 ppm; can be produced by yeast during the process of sulfur reduction; in aqueous solution exists as H_2SO_3 at low pH, as HSO_3^- at wine pH

Sulfuric Acid: H_2SO_4; a strong acid; the titratable acidity of wine is expressed in terms of sulfuric acid equivalents rather than as tartaric acid equivalents in some wine producing regions

***Sur Lie*:** Term referring to the aging of wine in the presence of the yeast lees or residue; allows autolysis to occur and for characteristic changes in the composition of the wine due to the action of yeast enzymes; also called extended lees contact in barrel aging

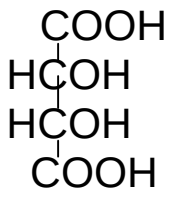
Survival Factor: Term for nutrients required by yeast to maintain ethanol tolerance and therefore viability at high ethanol concentrations; sterols, unsaturated fatty acids and

molecular oxygen are survival factors

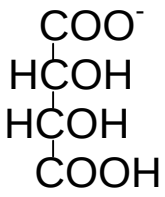
Suspended Solids: Particulate matter remaining suspended in the juice following draining or pressing; typically on the order of 1 – 2% on a v/v basis

Tannin: General term for polymeric phenols including procyanidins as well as non-flavonoid polymers

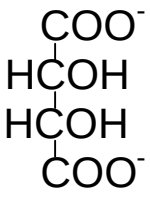
Tartaric Acid/Tartrate: One of the two principle organic acids found in grapes (along with malate); dicarboxylic; can crystallize from wine having the appearance of ground glass



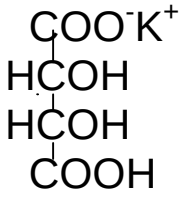
Tartaric Acid

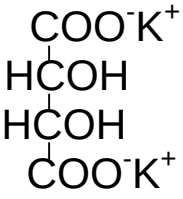


Bitartrate



Tartrate





Potassium bitartrate Potassium tartrate

Taxonomy: The study of the general principles of scientific classification; systematics; the orderly classification of microbes, plants and animals according to physiological traits; phylogeny: taxonomic scheme based on evolutionary relationships between organisms

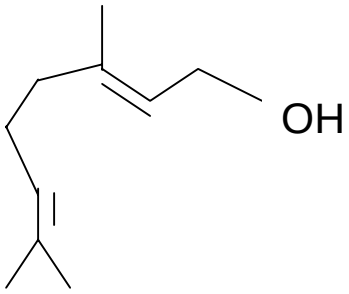
TCA: an abbreviation with no less that three relevant meanings: Tricarboxylic Acid Cycle (metabolism); Trichloroacetic Acid (reagent); Trichloroanisole (corkiness)

Terpene: Class of compounds derived structurally from C5isoprene units important in wine aroma; occur as linear or cyclic forms; present as alcohols, aldehydes; acids; ketones; esters; hydrocarbons; can occur free (and sensorally detectable) or as bound forms or glucoconjugates

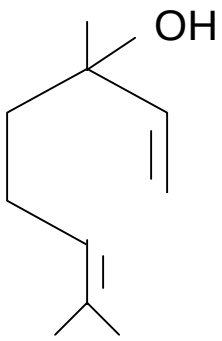
Isoprene: $CH_2=C(CH_3)-CH=CH_2$

Terpenes with: 2 isoprene units (C10): monoterpenes
3 isoprene units (C15): sesquiterpenes
4 isoprene units (C20): diterpenes
6 isoprene units (C30): triterpenes
8 isoprene units (C40): tetraterpenes

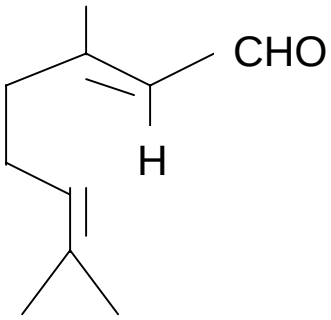
Common terpenes of wine:



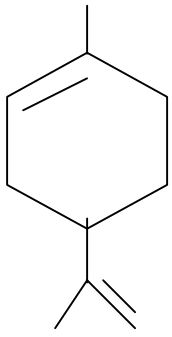
Geraniol



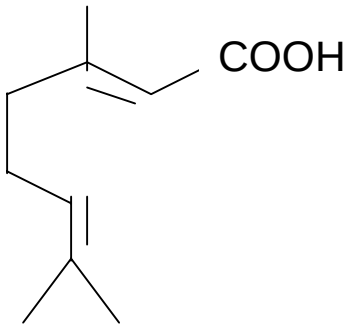
Linalool



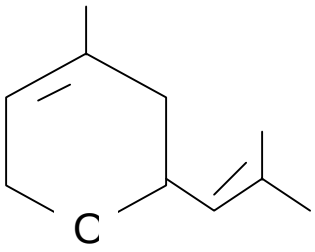
Geranial



Limonene



Geranic Acid



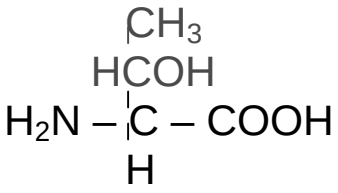
Nerol oxide

Terpenol: A terpene alcohol

Terroir: Term coined by the French to refer to the influence of regional topography (soil, geography) on wine composition; some authors also include climate as a component of terrior: the totality of environmental influences; while others include "the human element", the impact of viticultural and winemaking practices of a region.

Thiamin Pyrophosphate: Coenzyme required for non-oxidative and oxidative decarboxylations of α keto acids forming α ketols; required by pyruvate decarboxylase for the generation of acetaldehyde and carbon dioxide during fermentation; can form an adjunct with sulfite thereby eliminating cofactor activity

Threonine: Polar amino acid containing a hydroxyl group; 3 letter code: Thr; 1 letter code: T; mw: 119.12; pKa: 2.63; 10.43; pI: 6.53



Titratable Acidity: Term for the expression of the acidity of a juice, must or wine determined from the amount of base needed to tritrate the wine to a specific end point pH; in the US, the pH end point is 8.2 and the acidity is expressed as grams equivalent of tartaric acid; in France, the end point is 7.0 and the acidity is expressed as grams equivalent of sulfuric acid

Titrate: Perform or subject to titration

Titration: The concentration of one substance in solution (sample) can be determined by allowing it to react with another substance of known concentration in a different solution (titrant) to a detectable equilibrium or equivalence (end) point; titration is the term for the method used to determine the concentration of one compound from the

concentration of another by mixing the two until an equilibrium point is attained; useful for determination of acids and bases and for oxidation reduction reactions; the concentration of the unknown compound (U) can be determined from the concentration of the known (K) compound from its normality and volume needed to reach the end point:

$$\text{Volume of U} \times \frac{\text{Grams of U}}{\text{Equivalent Wt of U}} = \text{Normality of K} \times \text{Volume of K}$$

OR: $N_K V_K = N_U V_U$

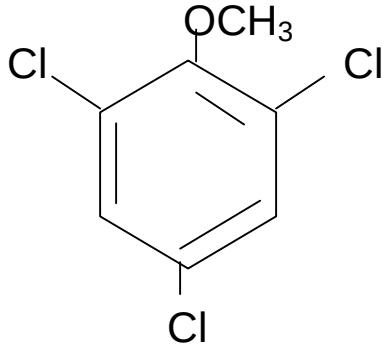
Where N_K is the normality of the known compound, K, V_K is its volume used to neutralize the unknown, V_U is the volume of the unknown and N_U is the calculated normality of the unknown compound, since following titration N_K, V_K, V_U are all known. The solution of K must be accurately made in order to obtain the true value of U.

Total Acidity: Refers to the sum of the concentration of the acid anionic species present in wine; the sum of the fixed and volatile acidity; the concentration of anionic species can be determined using a technique such as HPLC analysis

Transmittance: in spectrophotometry, the amount of light allowed through a solution.

Trehalose: Disaccharide of glucose (α-D-glucopyranosyl α-D-glucopyranoside) found in yeast and other organisms; protective agent against stress, particularly stress caused by osmotic shock, dehydration and high ethanol concentration; can be degraded and used as an energy source, but no longer thought to be primarily a storage form of glucose

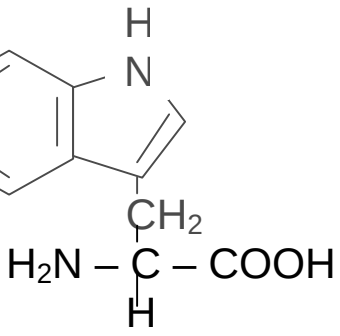
Trichloroanisole (TCA): Compound associated with cork taint “corkiness”, an odor reminiscent of moldy rags; produced by various species of molds during the processing of corks; can also be produced in the winery if care is not taken with the use of chlorine-based sanitizing agents



2,4,6-Trichloroanisole

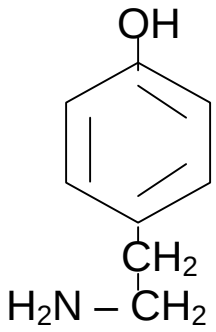
Other compounds associated with cork taint: geosmin; 2-methyl isoborneol; 1-octen-3-one; 1-octen-3-ol, guaiacol

Tryptophan: A non-polar aromatic amino acid; 3 letter code: Trp; 1 letter code: W; mw: 204.22; pKa: 2.38; 9.39; pI: 5.88

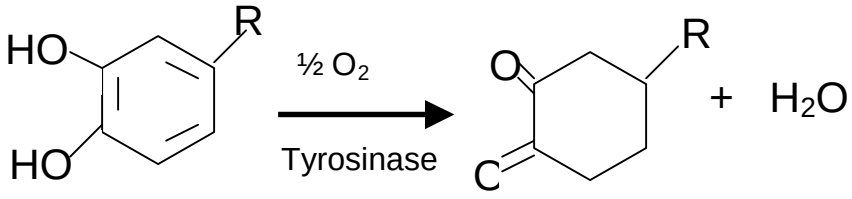


Tyndall Effect: When a beam of light is passed through a solution the path of the beam is visible due to the scattering of light caused by particles in the solution this is called the Tyndall Effect; the amount of scattering is a function of the concentration of particles in the solution; a “Tyndall Box” is a device used to assess the clarity of wines; Tyndallization refers to the process of heating a sample with steam for a short period (30 min) of time sequentially over a period of three days as a means to sterilize the sample; the principle being that the heat treatment will kill vegetative cells but not sports, time is allowed for spores to germinate after the heat treatment so that they can then be killed by a subsequent heat treatment; not as reliable as autoclaving

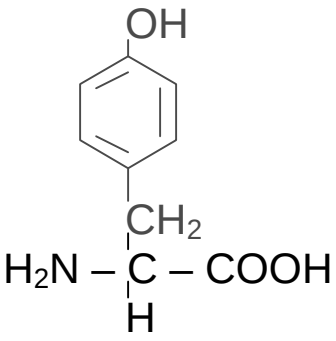
Tyramine: A biogenic amine produced from the decarboxylation of tyrosine



Tyrosinase: A copper-containing enzyme that promotes the oxidation of phenols (as tyrosine) and is widespread in plants and animals; oxidizes diphenols forming brown reaction products



Tyrosine: A polar aromatic amino acid; 3 letter code: Tyr; 1 letter code: Y; mw: 181.19; pKa: 2.20; 9.11; 10.07 (phenolic hydroxyl); pI: 5.65



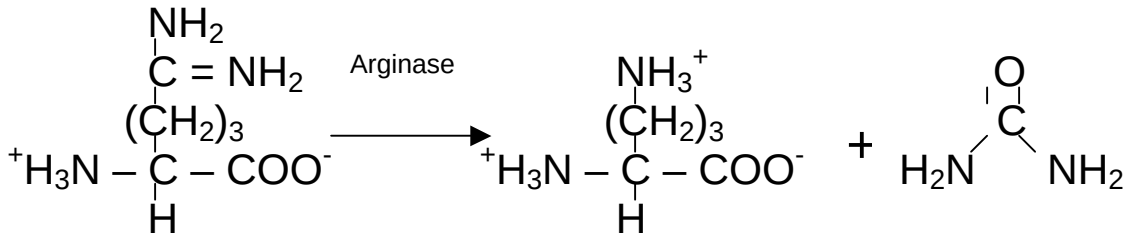
Ullage: Generally the head space in a bottle or barrel; area not occupied by wine due to evaporative loss of ethanol and water

Ultrafiltration: Filtration with an exclusion limit (MWCO) effective against macromolecules, for the removal of proteins and tannins; see filtration

Units of Measurement: Heat; Length; Mass; Volume; Unit conversions; Working with Units

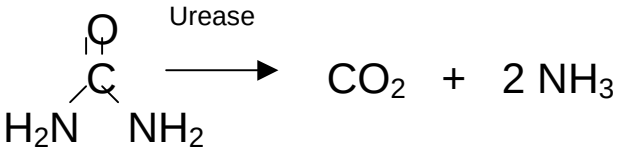
Unsaturated: In a solution, means that the solute is present at a concentration below its maximal saturation; in hydrocarbon chains, means that the molecule is not fully protonated, that is, one or more double bonds between two carbons exists

Urea: Compound produced from the degradation of arginine, a major amino acid found in grape juice; important precursor of ethyl carbamate

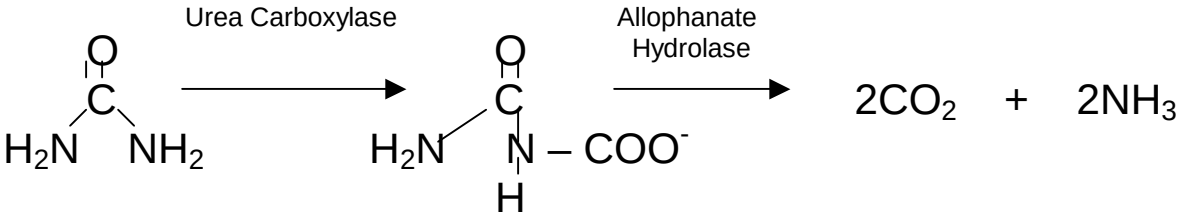


Arginine Ornithine Urea

Urease: Enzyme converting urea to one molecule of carbon dioxide and two molecules of ammonia; can be used in wine to reduce potential for ethyl carbamate; found in many organisms but not in *Saccharomyces*; *Saccharomyces* possess the enzyme urea amidolyase which is actually a difunctional enzyme possessing two catalytic activities: urea carboxylase and allophanate hydrolase



Urea amidolyase



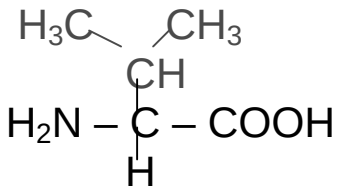
Urea Allophanate

Urethan/Urethane: Alternate name for ethyl carbamate

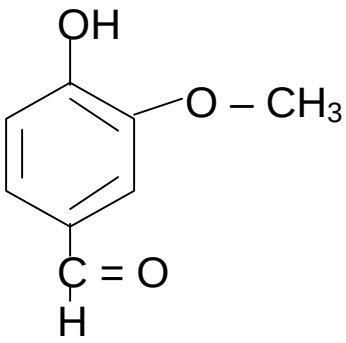
Vacuole: Membrane bound subcellular organelle found in eukaryotes; called lysosome in animal cells and vacuoles in fungi and plants; site of hydrolysis of macromolecules; site of storage

Valence: Number of hydrogen atoms which one atom of an element combines with or replaces

Valine: A non-polar amino acid; 3 letter code: Val; 1 letter code: V; mw: 117.15; pKa: 2.32; 9.62; pI: 5.97



Vanillin: Phenolic aldehyde found in grapes and especially extracted from barrel wood during aging; responsible for a vanilla note in wines



Vascular: Containing channels or passageways for the movement or circulation of fluid such as the blood stream in animals and phloem and xylem in plants; the system of such channels

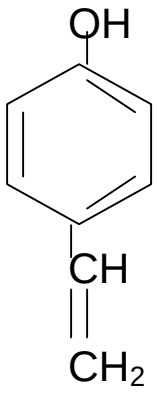
Veraison: Term for the initiation of the process of ripening of grapes; grape cell walls soften; berry swells; gains color; undergoes changes in composition of the fruit; followed by maturation

Viable: Living, in microorganisms generally means capable of reproduction under some condition, not necessarily under the current conditions

Viability: Refers to the property of being viable

Vinyl: Refers to a double bond between two carbon atoms: -CH=CH-

Vinyl Phenol: A phenol compound with an attached moiety possessing a vinyl group; produced by the yeasts *Dekkera*/*Brettanomyces* and is associated with their presence in the wine

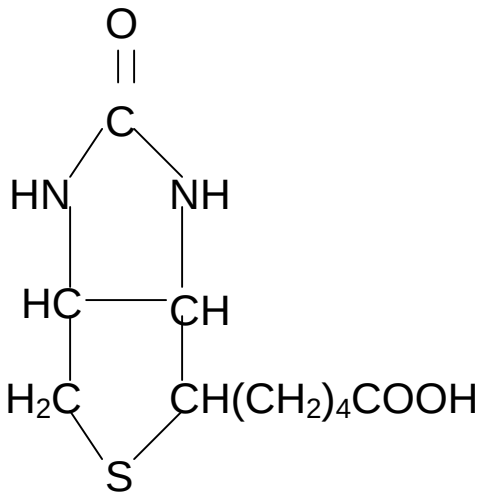


Viscosity: Internal property of a fluid that resists flow of the fluid; colloquially the thickness of a fluid; affected by temperature; expressed in terms of Pascal seconds (Pa•s); important consideration in the design of juice, must and wine transfer methods

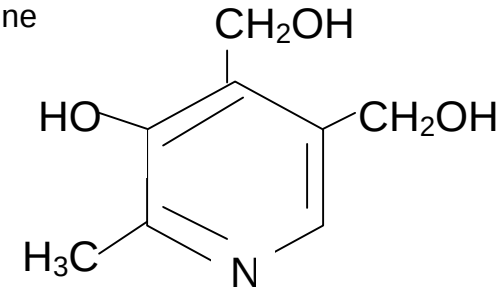
Vitamer: Term for multiple forms of the same vitamin

Vitamin: Organic compound generally required in minute amounts as a growth factor; are generally precursors of coenzymes; Saccharomyces does not seem to require the fat soluble vitamins (Vitamin A, E, K_1, K_2) required by animal cells nor do they require the steroid derivative Vitamin D, but they are good dietary sources of ergosterol the precursor for vitamin D in humans; Vitamins used by *Saccharomyces*: biotin (Vitamin H), inositol, nicotinamide, pantothenate, pyridoxine (Vitamin B_6), riboflavin, thiamin (Vitamin B_2) ; *Saccharomyces* generally only requires biotin, that is, can synthesize the other components *de novo*; some strains require pantothenic acid, and some require inositol and thiamin, but growth and metabolism is stimulated if all vitamins are present

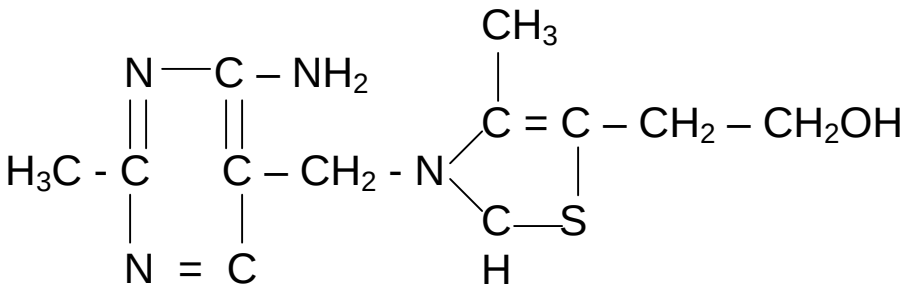
Biotin



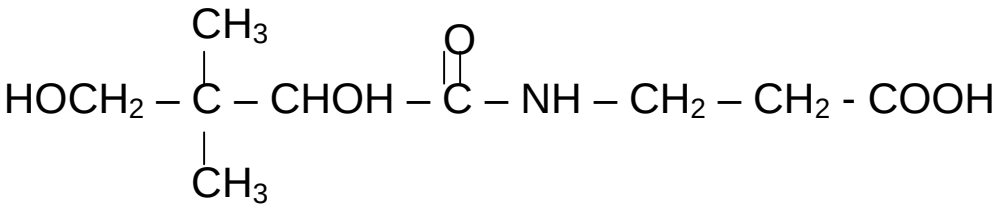
Pyridoxine



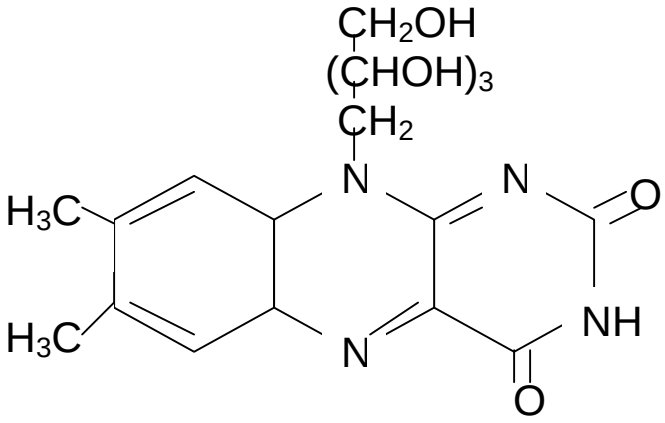
Thiamine



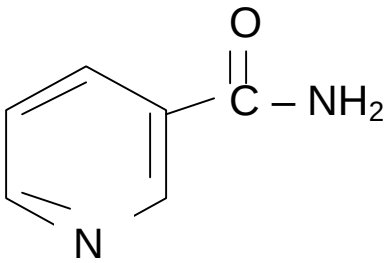
Pantothenic Acid (needed for coenzyme A synthesis)



Riboflavin



Nicotinamide



***Vitis*:** Genus name for grapes used in wine making, the principle grape used is *V. vinifera*; one of 14 genera in the family *Vitaceae;* there are roughly 60 species of *Vitis*; other species are important sources of rootstock and disease resistance

Volatile/Volatility: The tendency of an element, compound or molecule to exist in the vapor phase in a solution of the compound; affected by temperature and pressure; taken advantage of in the analytical methods based on distillation

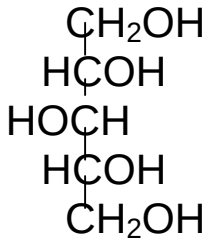
Volatile Acidity: Distillable acid species; in wine, refers to acetic acid

Wort: In brewing, the liquid formed from soaking mash in hot water, which is then fermented to make beer

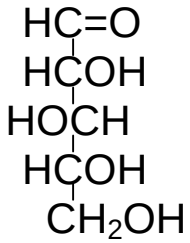
Xylella: Genus of bacteria; *X. fastidiosa* is the causative agent of Pierce's Disease, an infection of the xylem leading to blockage of water flow and death of the plant; transmitted by insect vectors such as the Glassy Winged Sharp Shooter

Xylem: Along with the phloem, comprises the vascular system of the plant; conducts water and dissolved nutrients absorbed from the soil by the root system to the rest of the plant

Xylitol: Sugar alcohol derived from xylose, not metabolized to any extent by *Saccharomyces*



Xylose: Pentose found in grapes, juices, musts and wine; not metabolized by *Saccharomyces*



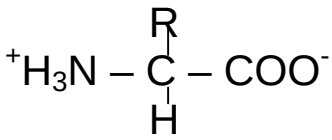
Yeast: Unicellular fungus reproducing by budding or fission

Yeast Hulls: Also called yeast ghosts; term for yeast cell walls and associated membranous material following lysis of the cells; used to stimulate yeast fermentation

Zinc: Metal element of the periodic chart with an atomic number of 30 and an atomic mass of 65.38; important cofactor for alcohol dehydrogenase and fermentation; can be found at fairly high concentration in wine (up to 4 mg/L) due to contamination from the

vineyard with trellising wire or pesticides

Zwitterion: Name derived from the German expression for double ion; refers to a dipolar molecule; a molecule carrying a positive charge in one region and a negative charge in another as in amino acids under physiological conditions



***Zygosaccharomyces*:** Genus of yeast involved in wine spoilage; principally *Z. bailii*; strains possess vigorous fermentation rates and can conduct fermentation of grape juice to dryness; resistant to potassium sorbate and to high substrate concentrations, therefore *Zygosaccharomyces* is a frequent cause of spoilage of juice concentrate; primarily a cosmetic (turbidity) problem; does not produce off characters