Acidity and Blending

The art of using Titratable Acidity as a tool for blending consistency

An Acid is a Species having the tendency to lose a Proton. [H+]

[H+] cation + [GLOB-] anion

pH related benefits in brewing

- Enzymatic reactions in mash
- Metabolism of yeast
- Alpha Acid Extraction
- Color Extraction
- Microbial Stability
- Forcing Reactions
- Flavor Perception
- Monitoring Yeast Health

What's all the fuss with TA?

The total amount of hydrogen ions present in the sample with the exception of those bound to alkaline ions. The hydrogen ions can be either attached to acids or in the form of free ions or anions. Titratable acidity is different than total acidity, although at times both terms are used to mean the same thing. Total acidity is the total amount of organic acids in the sample. This includes all weak beer acids (i.e. lactic, acetic, succinic, tartaric).

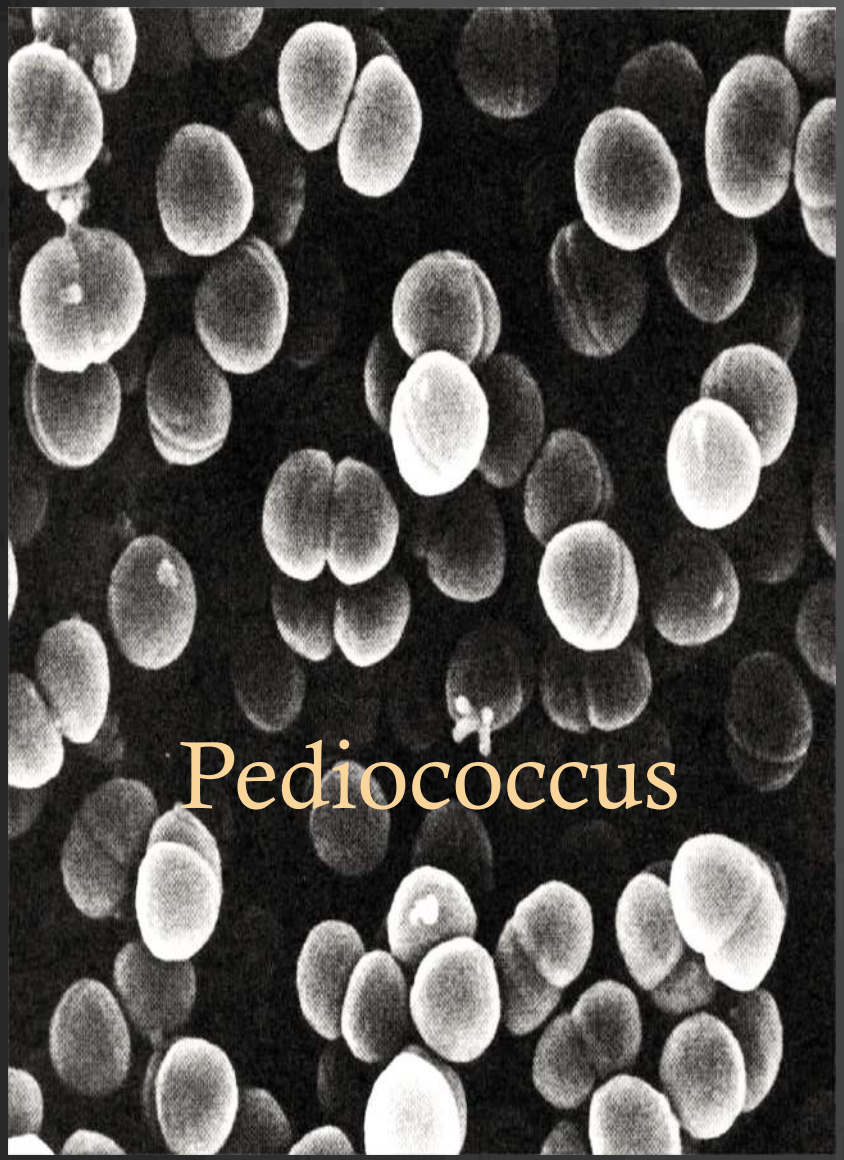
What's the difference?

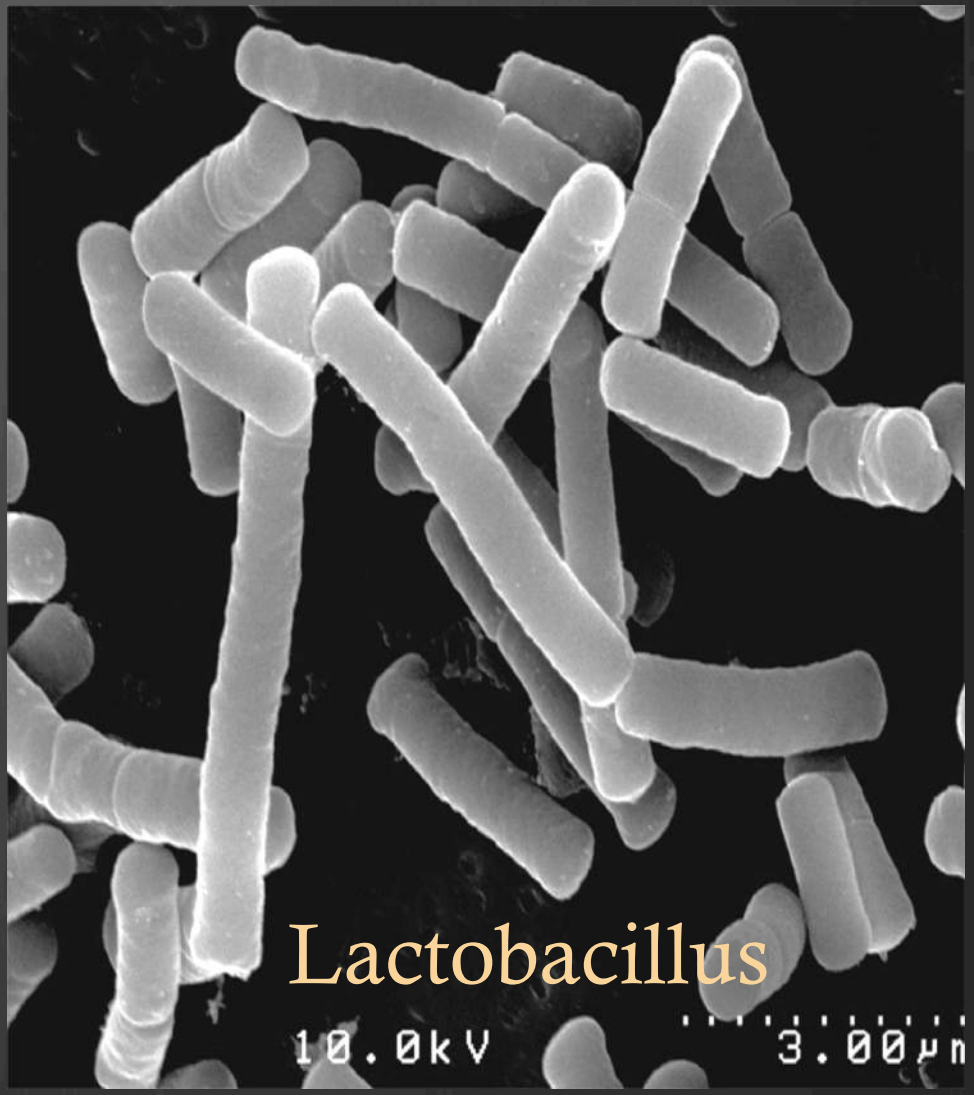
pH	**Measures concentration of only disassociated hydrogen ions [H+] in solution**
T.A.	**Measure of the total [H+] ion concentration in solution floating freely and those ions still tied up in bonds**

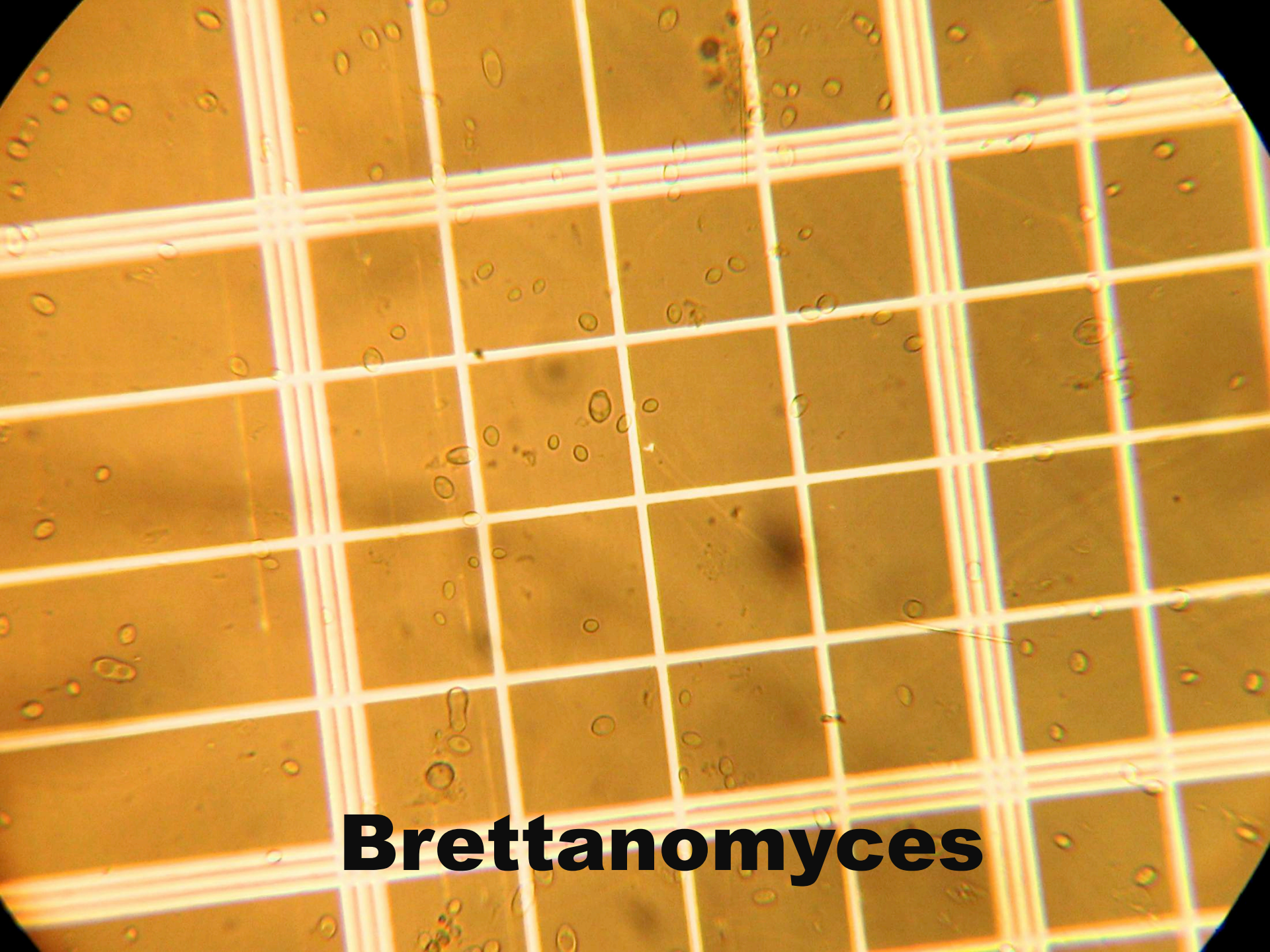
pKa Values and Acid Strength

Acid	pKa_1	pKa_2	Mass/Mole
Tartaric	3.02	4.54	150
Citric	3.03	4.74	192
Malic	3.40	5.05	134
Lactic	3.86	--	90
Ascorbic	4.04	11.8	176
Succinic	4.12	5.6	118
Acetic	4.76	--	60

The lower the pKa value the stronger the acid


Pediococcus


Lactobacillus
10.0kV
3.00µm


Brettanomyces

Habitats

	salt	Alcohol tolerance	Lactic acid	Acetic acid	starch	time	oxygen	temp, F
Saccharomyces	-	20%, P	pH 4.5	0.5%	-	2	+	40-95
Brettanomyces	-	15%, P		P		4-100	+	40-95
Lactobacillus	8%	8%	1% P	-		4	-	60-150
Pediococcus			2% P, pH 3.4		+	100	--	
Acetobacter	-	6-18%		8% P		30	++	70-110
Enterobacteriaceae		2%, P	pH 4.4, P	0.5%, P		2	+	
molds		-	-	--		5	++	<100

P produces
-- toxic

++ required
-, + minor effect

tactile

Adjective

1. of, pertaining to, endowed with, or effecting the sense of touch.
2. perceptible to the touch, tangible.

Procedure for measuring g/L Lactic Acid in beer

Items Needed: pH meter, stir plate and stir bar, 10ml pipet and pipet pump, 10ml cylinder, .1 N NaOH, 250ml beaker, distilled water.

1. Place the pH probe in stand and center the probe above the stirrer plate.
2. Draw 10 milliliters (ml) of beer into the pipette and transfer it into the beaker.
3. Add 90 ml of distilled water to beaker and place the stir bar in the beaker.
4. Place the beaker on the stirrer plate. Adjust the probe-stand so the probe is immersed in the sample but do not allow the stir bar to strike the end of the probe.
5. Turn the stirrer on.
6. Fill the 10ml pipet with 0.1 N sodium hydroxide solution.
7. Titrate the beer sample while watching the pH meter.
8. If needed, refill the 10ml pipet with .1NaOH solution making sure to quantify portion used.
9. Stop the titration when the pH meter reads 8.2.
10. Multiply ml of NaOH used in titration by .9 to read grams/Liter Lactic Acid.
11. Discard the solution, rinse probe with distilled water and store in pH 4 solution.

Parts per million (ppm) = mg/L

.1g/100mls = 1gram/L = 1000ppm = .1%

10,000 ppm = 1%

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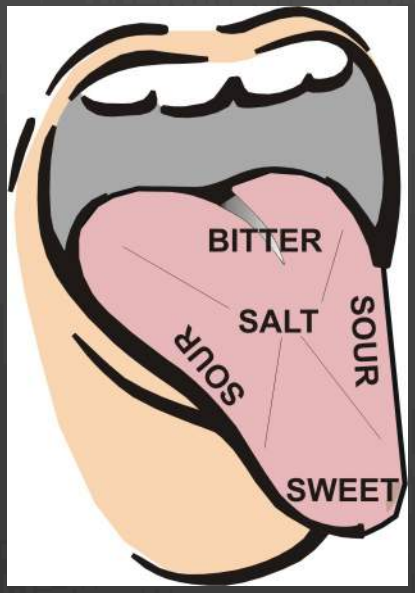


Titration Calculation

Multiply amount of .1N NaOH used to titrate sample to pH 8.2 endpoint by .9

To express results in g/L lactic = mls .1N NaOH X .9

Example:

5.0 mls .1N NaOH used in sample X .9
=4.5 g/L lactic acid
=4500ppm lactic acid in sample

Sample	pH	TA g/L Lactic
Agrestic 8.28.12	3.19	7.11
Agrestic 10-24-12	3.26	7.47
Agrestic 6-5-13	3.67	3.9
Agrestic 11-25-13	3.49	5.4
Agrestic 8-6-17	3.34	6.57
Agrestic 2013 draft	3.47	4.77
Agrestic 2014 draft	3.51	5.13
Cowbell #1	3.1	10.71
Cowbell #2	3.03	11.8
Cowbell #3	3.1	10.89

Bench Blending Equation

$$(A_{vol})(T.A.) + (B_{vol})(T.A.) = (A_{vol} + B_{vol}) \times (T.A.x)$$

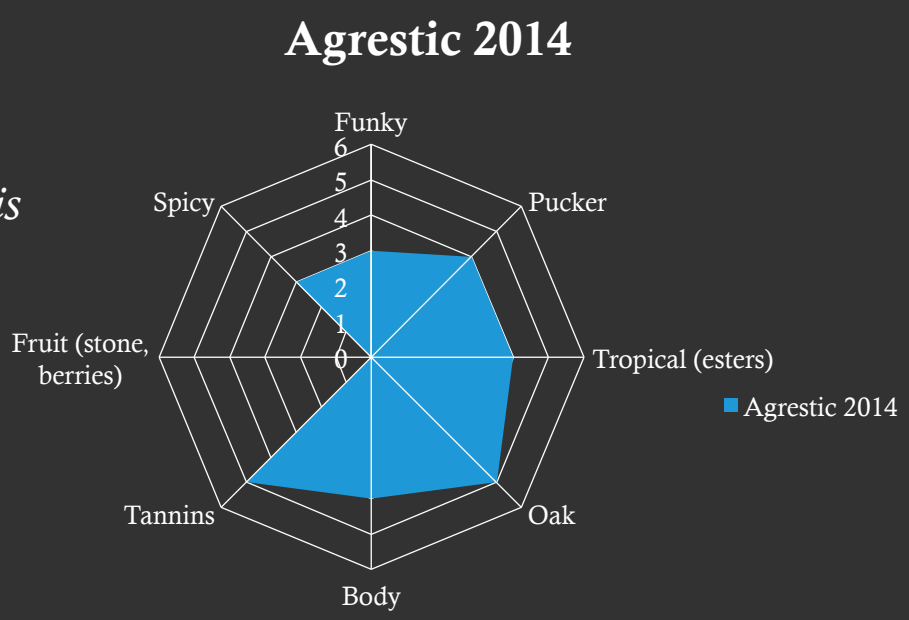
<10% into anything is almost not detectable.

Sensory will dictate end decision

Agrestic 2014 Specs

Barrel	Ratio	Maturation time
French Oak	87%	8-28 months
American Oak	13%	8-28 months

Specs:
ABV: 6.2% kegs; 6.6% bottles
Color (srm) 14.8
T.A.: 6.5 g/L
Micro Flora: B. *lambicus*; L. *lindneri*; L. *brevis*
Cases: 600 (12 X 375 ml bottles).



Preliminary Analysis Report

AF25632	Feral Vinifera			
	Citric Acid	None detected		HPLC*
	Tartaric Acid	0.196	g/100mL	HPLC*
	Malic Acid	None detected		Enzymatic
	Lactic Acid	0.670	g/100mL	HPLC*
	Acetic Acid	0.138	g/100mL	HPLC*
	Succinic Acid	0.019	g/100mL	Enzymatic*
	Organic Acid Profile Total	1.023	g/100mL	HPLC*
	Volatile Acidity	0.108	g/100mL	Cash Still
AF25633	Bretta Rose			
	Citric Acid	None detected		HPLC*
	Tartaric Acid	0.007	g/100mL	HPLC*
	Malic Acid	None detected		Enzymatic
	Lactic Acid	0.679	g/100mL	HPLC*
	Acetic Acid	0.322	g/100mL	HPLC*
	Succinic Acid	0.013	g/100mL	Enzymatic*
	Organic Acid Profile Total	1.021	g/100mL	HPLC*
	Volatile Acidity	0.189	g/100mL	Cash Still
AF25634	Agrestic			
	Citric Acid	None detected		HPLC*
	Tartaric Acid	None detected		HPLC*
	Malic Acid	None detected		Enzymatic
	Lactic Acid	0.457	g/100mL	HPLC*
	Acetic Acid	0.250	g/100mL	HPLC*
	Succinic Acid	0.015	g/100mL	Enzymatic*
	Organic Acid Profile Total	0.722	g/100mL	HPLC*
	Volatile Acidity	0.086	g/100mL	Cash Still

AF25640	St Louis Gueze			
	Citric Acid	None detected		HPLC*
	Tartaric Acid	None detected		HPLC*
	Malic Acid	None Detected		Enzymatic
	Lactic Acid	0.696	g/100mL	HPLC*
	Acetic Acid	0.167	g/100mL	HPLC*
	Succinic Acid	0.018	g/100mL	Enzymatic*
	Organic Acid Profile Total	0.881	g/100mL	HPLC*
	Volatile Acidity	0.085	g/100mL	Cash Still
AF25641	Cantillon Gueuze			
	Citric Acid	None detected		HPLC*
	Tartaric Acid	None detected		HPLC*
	Malic Acid	None Detected		Enzymatic
	Lactic Acid	0.414	g/100mL	HPLC*
	Acetic Acid	0.249	g/100mL	HPLC*
	Succinic Acid	0.035	g/100mL	Enzymatic*
	Organic Acid Profile Total	0.698	g/100mL	HPLC*
	Volatile Acidity	0.176	g/100mL	Cash Still
AF25642	Monks Cafe			
	Citric Acid	0.015	g/100mL	HPLC*
	Tartaric Acid	None detected		HPLC*
	Malic Acid	0.006	g/100mL	Enzymatic
	Lactic Acid	0.368	g/100mL	HPLC*
	Acetic Acid	0.149	g/100mL	HPLC*
	Succinic Acid	0.014	g/100mL	Enzymatic*
	Organic Acid Profile Total	0.552	g/100mL	HPLC*
	Volatile Acidity	0.086	g/100mL	Cash Still

AF25637	Bretta Weisse			
	Citric Acid	None detected		HPLC*
	Tartaric Acid	None detected		HPLC*
	Malic Acid	None Detected		Enzymatic
	Lactic Acid	0.439	g/100mL	HPLC*
	Acetic Acid	0.207	g/100mL	HPLC*
	Succinic Acid	0.015	g/100mL	Enzymatic*
	Organic Acid Profile Total	0.661	g/100mL	HPLC*
	Volatile Acidity	0.097	g/100mL	Cash Still
AF25638	Lil Opal			
	Citric Acid	None detected		HPLC*
	Tartaric Acid	None detected		HPLC*
	Malic Acid	None Detected		Enzymatic
	Lactic Acid	0.098	g/100mL	HPLC*
	Acetic Acid	0.181	g/100mL	HPLC*
	Succinic Acid	0.019	g/100mL	Enzymatic*
	Organic Acid Profile Total	0.298	g/100mL	HPLC*
	Volatile Acidity	0.088	g/100mL	Cash Still
AF25639	Duchesse De Bourgogne			
	Citric Acid	None detected		HPLC*
	Tartaric Acid	None detected		HPLC*
	Malic Acid	None detected		Enzymatic
	Lactic Acid	0.393	g/100mL	HPLC*
	Acetic Acid	0.250	g/100mL	HPLC*
	Succinic Acid	0.024	g/100mL	Enzymatic*
	Organic Acid Profile Total	0.667	g/100mL	HPLC*
	Volatile Acidity	0.228	g/100mL	Cash Still

Volatile Acids

Acetic
Butyric
Propionic
Formic

TTB standards for allowable Volatile Acidity in Wine
Red Wine = 1400ppm
White Wine = 1200ppm

Possible Sources of V.A.: Barrel Source, Environment, Equipment, Process, Cultures, Water.

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Acetic Acid Production

Ethanol + Air = Acetic Acid + Water

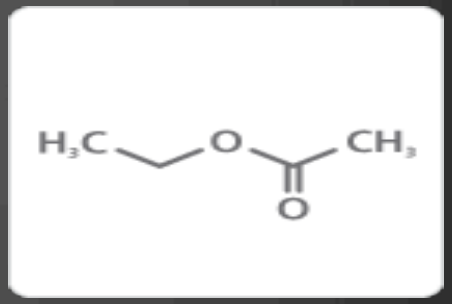
$C_2H_3OH + O_2 = CH_3COOH + H_2O$

Production Methods:

- Oxidation of ethanol
- Oxidative fermentation of ethanol involving *Acetobacter*
- Promoted in warm temperatures >70F

Vinegar minimum acceptable limits =
4-6% Acetic Acid (40-60g/L) or
40-60,000ppm

Ethyl Acetate - $C_4H_8O_2$



- Most common ester in beer
- Produced naturally by yeast fermentation
- Can be produced through the esterification of ethanol.
- Major ester of Acetic Acid
- Normally found @ levels of 8-70ppm in beer

@ Low Levels (5-10ppm): Tropical Fruits, Pineapple, Fruity
@ High Levels (>30ppm: Solvent, varnish, nail polish remover.


Liberated in Buellton, CA
FIRESTONE WALKER
BREWING COMPANY
No. of Cases: 500
BRETTA ROSÉ
WILD ALE
FERMENTED WITH RASPBERRIES
Matured Barrels: French Oak Puncheons
Time in Barrels: 6 months / Total Acidity: 9.3
Yeast: Brettanomyces Lambicus and Lactobacillus Brevis
ALC./VOL. 12.7 FL. OZ. 375ML
BARRELWORKS
@hopops
Photo Repost

Thank You Bend, OR

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