

Sour Beers: It's more than just pH

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Outline

Why this subject?

What is titratable acidity and how does it differ from pH?

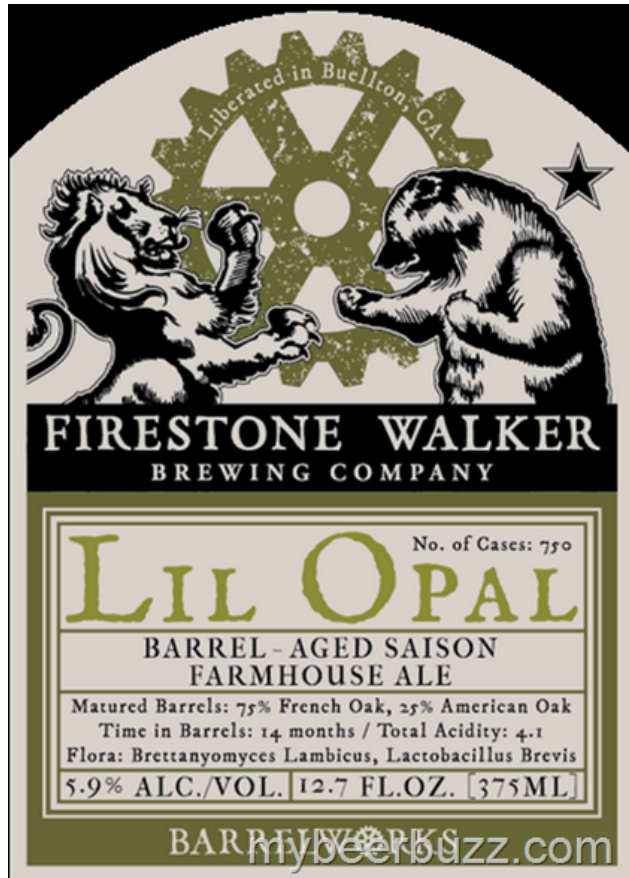
What acids are involved?

Experiments done at White Labs

Methods and materials for measuring TA

Ideas for the future

How did this subject come about?



Saw Firestone Walker label using it as a marketing tool

What does it mean to you?

Not much, but thought it was a cool way to describe something and possibly the wave of the future



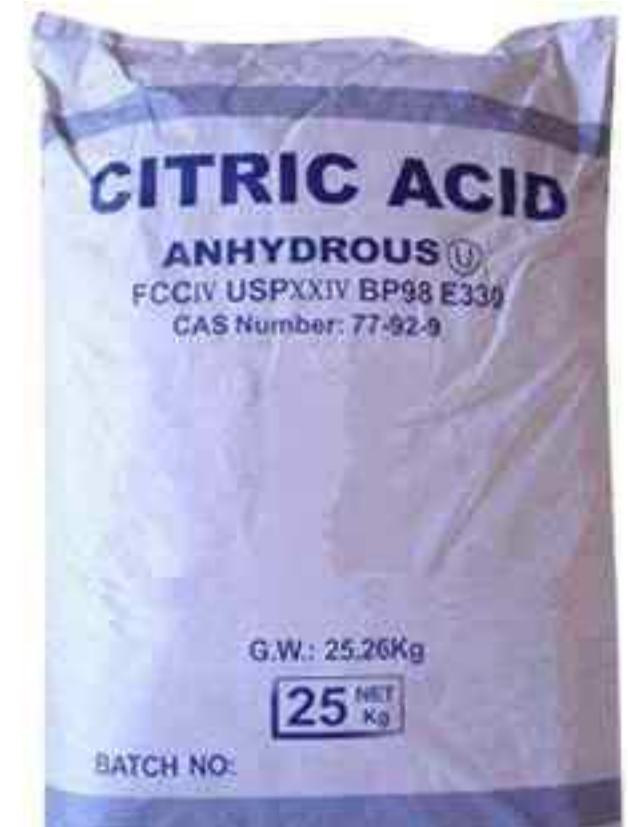
Total Acidity
4.1 g/L

Typical Sour Beers

- Fermented with *Saccharomyces* and inoculated with LAB and *Pediococcus* (Lactic acid)
- Typically aged in wood (Acetic acid potentially)
- Sometimes fruit is added – (citric acid)
- Sour is produced over the course of several months/years

Alternative methods becoming more popular for fast souring:

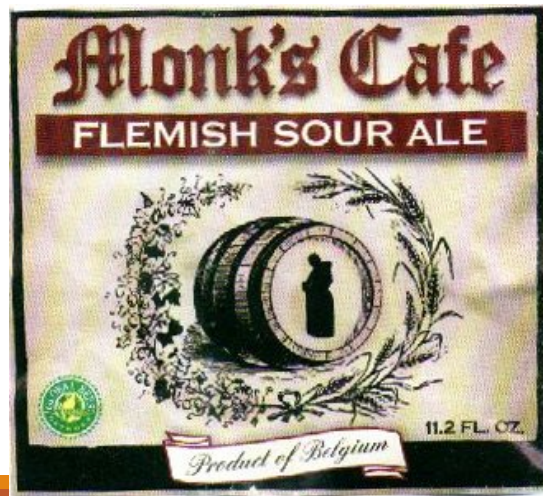
- Souring in the kettle
- Sour mash
- Lactic/ Citric acid additions



People want more sour

Regardless of how you feel about this, consumers are seeking really sour beers

In just a few short years, we seen a huge expansion in the market



Typical QC for a sour program

- Measuring pH
 - Looking for a drop or specific pH, typically the lowest we can get to 3.0 through fermentation (not adding acids)
- Tasting
- Or Nothing!
- Less common: Titratable acidity

Acidity and pH definitions for the layman

Two ways to measure acid in beer: **Titrateable acidity (TA)** and **pH**
Example)

Two ways to describe a person: Height and by Weight – both describe how BIG someone is but refer to something different

Two ways to describe acids: TA and pH- both describe how **STRONG** the acid is but refer to something different

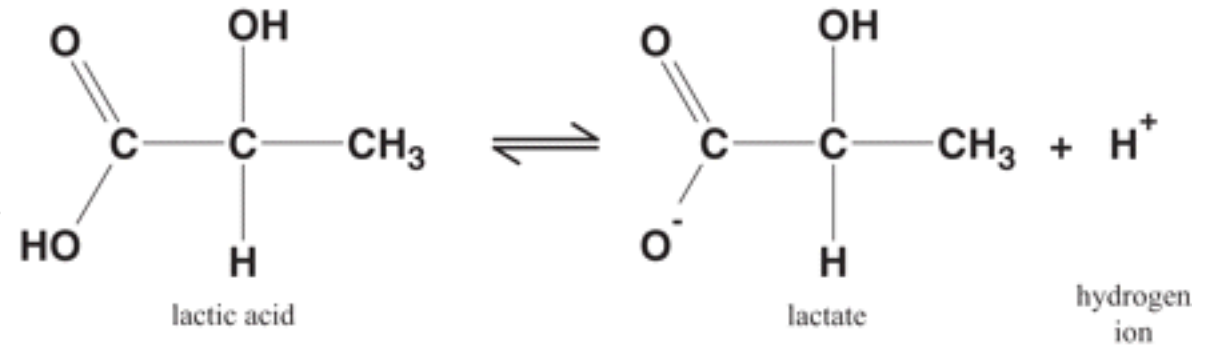
Total acidity is not the same thing although used interchangeably. What it really means is total titrateable acidity.



What is an acid?

[H⁺] cation + [GLOB⁻] anion

The GLOB is the part of the molecule that differentiates it from lactic, acetic, malic acid.



Organic vs Inorganic acids:

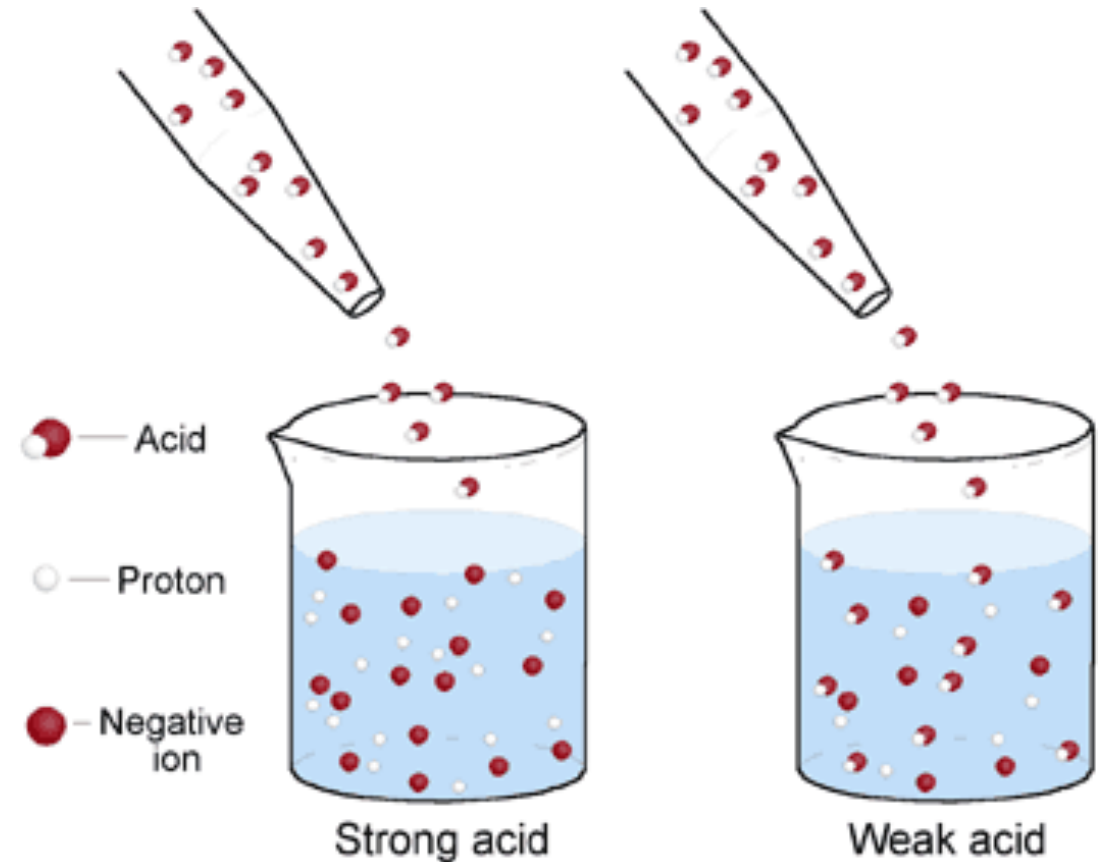
- Organic acids are what we have in beer/ wine/ food products
- They do not dissociate completely

Strong vs Weak Acids

The acids in fermentation are
WEAK ACIDS

- Stronger acids disassociate more than weak

- Organic acids we are dealing with are all weak acids



TA vs pH

TA and pH are not correlated or a direct relationship.

General rule of thumb, the lower the pH, higher the TA but not directly correlated

Titrateable acidity is measuring all of the $[H^+]$ associated and disassociated. Total $[H^+]$ concentration-ones floating around and ones that are disassociated in solution

pH is measuring only the disassociated

Why measure TA?

Because we taste acids associated and disassociated, and there are so many more bound $[H^+]$ than free

Acids in Sour Beer

Lactic – Soft tasting

LAB

Acetic- Vinegar, typically disliked

Acetobacter, Brettanomyces

Citric- sweet and sour sensory notes

Saccharomyces, fruit

Malic- strong tasting acid. Often reduced to lactic

Saccharomyces

Succinic (Kreb cycle)- salty, bitter taste

Saccharomyces

Sugar affects perception of acids.

Typically most sour beers are relatively dry.

- - Brett, low amounts extra fermentables because of bugs- unless pasteurizing

Volatile Acidity

In beer/wine consists mostly of acetic acid. Can also include butyric, isovaleric

In wine, TTB regulates V.A

Red.- 1400 ppm

White – 1200 ppm

Many samples were over legal limit

Beers F and H were close – near 1200ppm of acetic acid

Beer G was 2490 ppm of acetic acid

The Experiment!

11 Trained Panelists ranked sour beers from 0 to 3 – 0 not sour, 3 Extremely sour

Panelists attended a training where we defined descriptors and applied numerical values

Next day, panelist attended sessions. 4 and 4 beers in each session to avoid pallet fatigue

Many beers ranked off of the charts- over 3

I measured pH, TA, and Plato of the finished beers

Sour Sensory

Not a lot of information for products that are SUPER sour

Lowest to Highest Threshold of Acids

- Lactic
- Malic
- Acetic
- Citric

-Isovaleric and Isobutyric very low threshold

The Experiment!

8 beers tested for: pH, TA, organic acid profiles and sensory characteristics

Beer	pH	TA g/L	Acids- by HPLC	Plato	Sensory- 0 to 3 0 not sour, 3 extremely sour
Beer A	3.41	12.2	Lactic, Malic, Citric, Acetic	1.1	2.65
Beer B	3.57	10.6	Lactic, Acetic, Malic, Citric	0	2.25
Beer C	3.50	10.0	Lactic, Malic, Acetic, Acetic	2	2.54
Beer D	3.35	8.92	Lactic, Malic, Citric	2.1	1.95
Beer E	3.67	4.4	Lactic, Malic, Citric	3	1.5
Beer F	3.55	15.8	Lactic, Acetic, Malic, Citric	1.5	2.56
Beer G	3.52	13.8	Lactic, Acetic, Malic	1.5	2.51
Beer H	3.49	18.7	Lactic, Acetic, Malic	1.75	2.59

Confounding Factors

- Pallet fatigue
- Carbonation levels
- Alcohol levels
- Inability to distinguish super sour from super super sour
- Wide range of flavors from fruit, barrels, yeast strains, etc

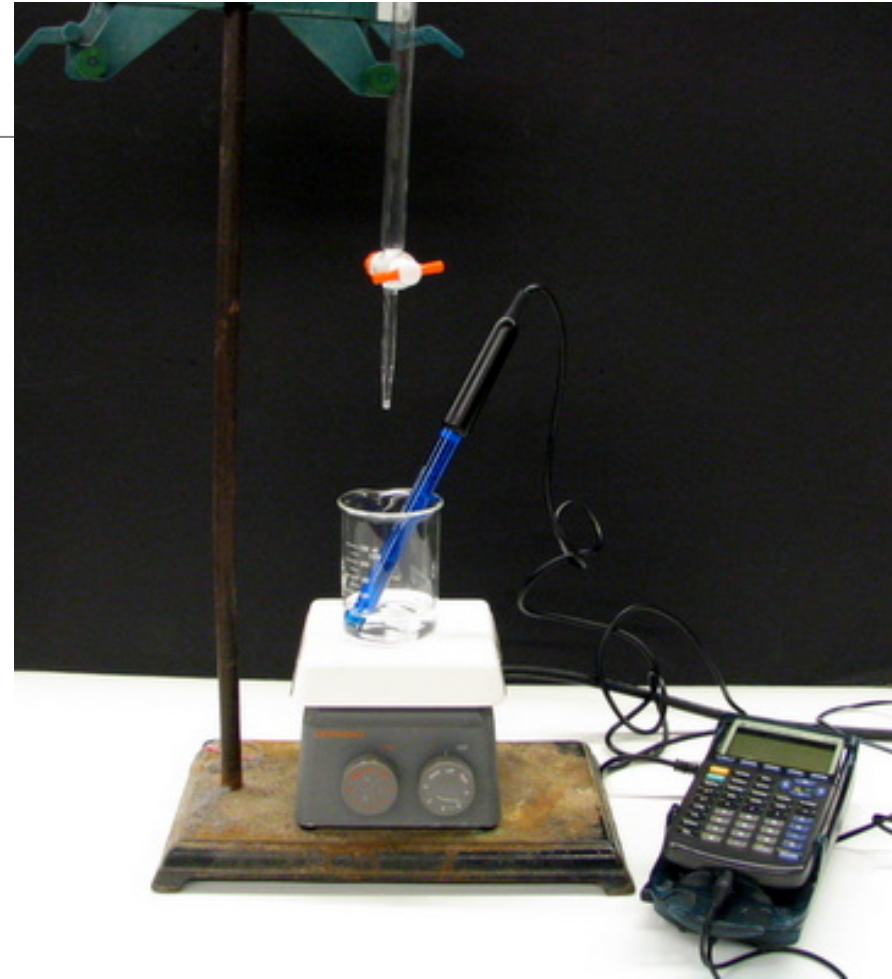
How to Measure TA

METHOD: ASBC Beer- 8

Potentiometric Method

Materials:

- A good pH meter with ATC
- 250 ml beaker
- Stir plate and stir bar
- Buret
- Pipette
- 0.1 N Sodium Hydroxide (NaOH)



pH meters

Preferably a benchtop or handheld unit

ATC control

- Electrode solution

- pH calibrations buffers 4 and 7 necessary

You will likely need to replace the probe every year



The method is easy!

- 1) Calibrate pH meter
- 2) Pipette 50 mls of decarbonated beer into beaker.
- 3) Place the pH probe in the solution enough to cover the tip
- 4) Record NaOH in the burette and titrate 1 ml of NaOH and watch the pH rise.
When you get close to 7.0 slow down and titrate slowly until pH 8.2.
- 5) Record the mls of NaOH used

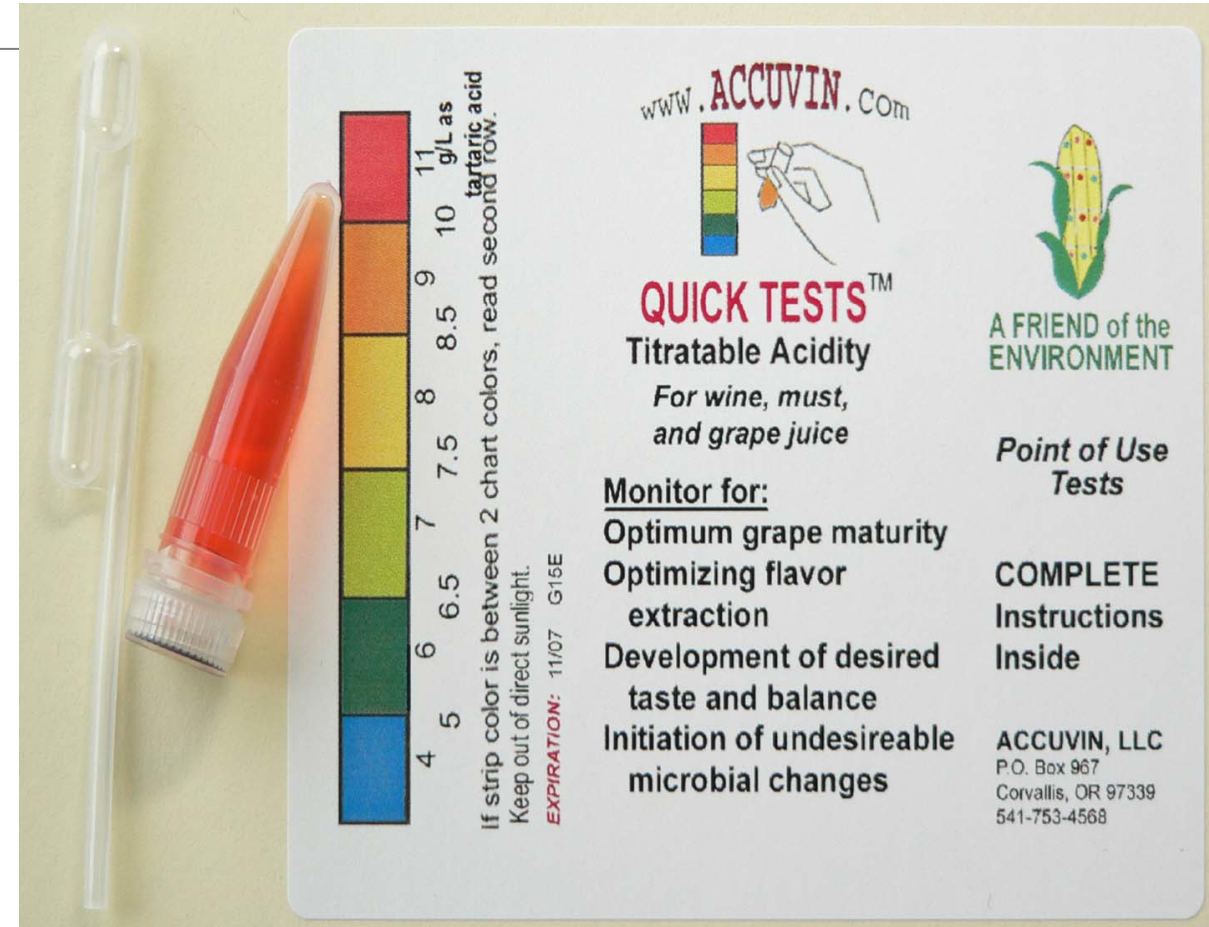
Other info needs: Specific Gravity of beer

Titratable Acidity (% lactic acid)= (mL 0.1N NaOH X 0.9)/ (ml beer x S.G)

Kits

Some kits available- look for the at wine making retailers

Realize with these your accuracy is going to go down



Using TA for a measurement to relate better to sensory

Typically TA related well the 'acid taste' of a beer

If TA doubles, people tend to perceive it as twice as acidic.

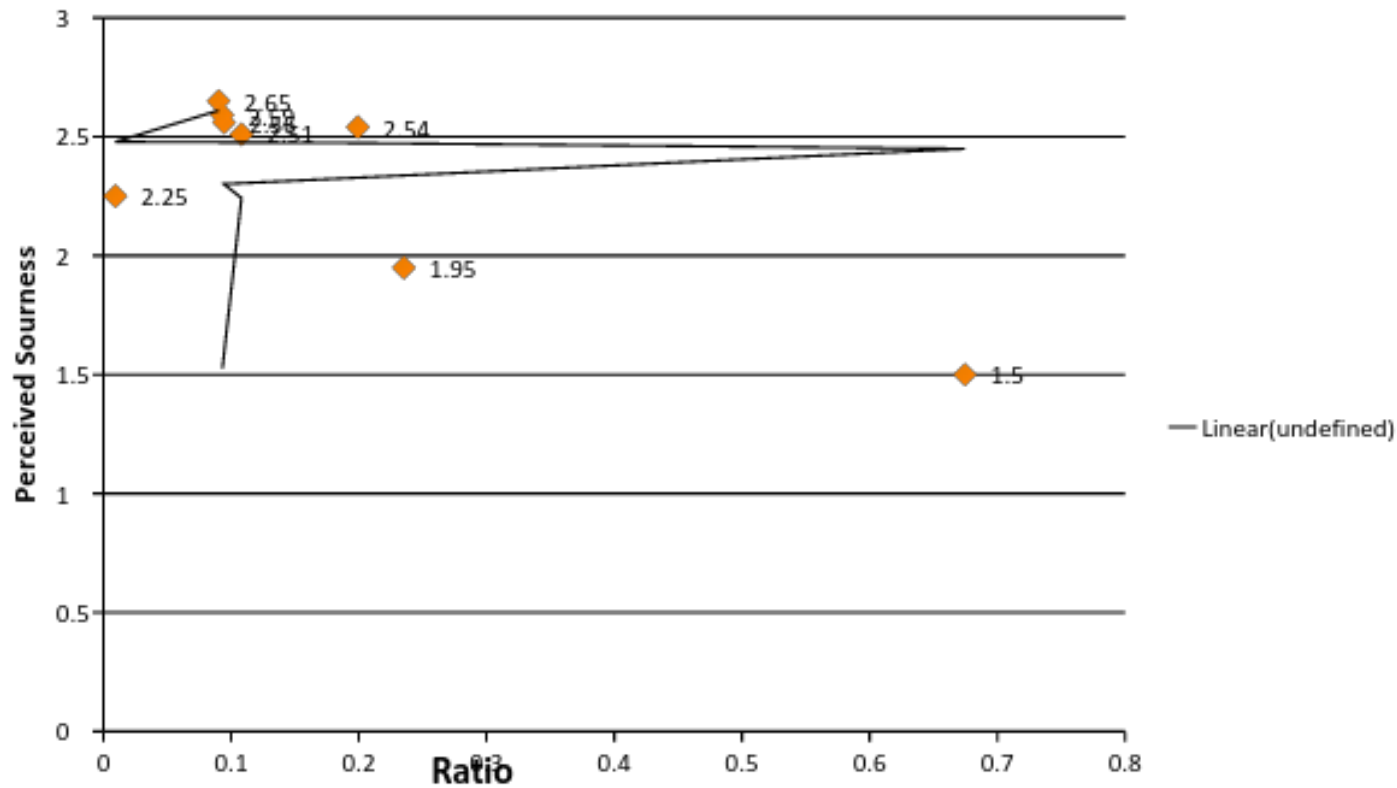
pH is a better indicator for microbial stability (i.e SO₂)

Learn from other food industries:

Try using a sweetness to acid ratio in sensory perception

Brix/TA – used in tomato products

Sweet/sour ratio vs Sensory Rating



More data points needed to see if this could be a good indicator but would be interesting to use as a prediction of sour perception

Summary

- Titratable acidity is a great resource to help assess the sourness of a beer compared to pH
- This is valuable for consistency, blending, slow fermentations
- Primarily we are tasting lactic acid, but many beer also have high acetic acid levels
- There is not a lot of data or research being done for sour sensory
- More work needs to be done to relate sourness to sensory ratings

Resources

American Society of Brewing Chemists Methods of Analysis

Acidity and Blending Powerpoint

Jim Crook- Firestone Walker

Thanks to my anonymous beer donors!

Thanks!

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