Strawberry Fields Forever

Once when I was a youth we helped a cooper put together an enormous vat in the basement. I was put inside with a lighted candle, and told to guide the top and base of the vat into the grooves of the staves, while the workers outside put on the broad iron bands and hammered them tight. When all was properly together, a small square was cut out of the top to let me out, the men reaching down to haul me out. This was much to the relief of the brewer's wife.

-Walter Rose, *Good Neighbours*, Cambridge, 1942; page 47

The significance of winning the gold medal in London at the 2002 Brewing Industry International Awards brings us to a point where we *put Pete's Wicked Strawberry Blonde* in an appropriate context. The category was for beers, which featured fruit, and this has been a category in serious beer competitions for some years.

The London accolades are described at http://www.brewingawards.org and we can briefly review that breweries from all over the world send their beers to be judged at this famous competition, one with a heritage going back to 1886. Beers are specially labeled and their normal labels are removed, as are all forms of ID besides the special double-blind codes assigned for each entry. Experienced, professional brewers evaluate the beers in a few broad categories, and make selections as a group. We really were so delighted to learn of a gold medal for both our *Wicked Strawberry Blonde* as well as one for the *Pete's Wicked Helles* in 2002!

The tradition of including fruit into beer is usually attributed to the Belgians. Our version of a strawberry-inclusive beer s a contrasting approach. Please enjoy afterwards the article in this series under "Winter Brew" and you might enjoy reading some notes found there concerning some Belgian specialty brews from the Senne Valley, just south of Brussels.

Our objective is to have a smooth beer which features a nice top note of strawberry. The traditional Belgian approach is to thoroughly infuse the fruit into the beer, to ferment it, and not only extract deep color, aroma, and flavor, but also to gain a tight almost-champagne effervescence.

It would be remiss to not share that the first version of this beer was created quietly in Minnesota by a talented brewer named Pat. Pat ran experiments on various strawberries and their liquid extract as he zeroed-in on just the right balance. Because crops change, as well as what we prefer for our beers, this Brewer would also be remiss if it was not acknowledged that *Wicked Strawberry Blonde* was improved a couple of years ago…'improved' is a strong word, but it is appropriate. We knew we wanted to move this wonderful brew to draft dispense, so we lowered the %RDF and adjusted the grist in mashing. We altered the fermentation protocol to increase natural esters, and when we found a reduction in acetaldehyde…we liked that. Acetaldehyde offers apple-like notes, specifically green-apple. Moving to a lower level was good.

Now the Belgian approach is as far from us as one could possibly be. That champagne-like bubbling is the consequence of many, many wild yeasts, and bacteria (such as *Brettanomyces*, which is one species which resides along with lactobacilli and wild yeasts in the wood used in tanks) that are natural in the Senne Valley. We use a pure brewing yeast culture in all our beers, and ours do not share that champagne-like prickling, nor do they have the acidic pH which is a consequence of the fermentations used in the Senne valley.

Instead of offering an analytical table here of our beer and of the other types of beer, the reader is referred to the Winter Brew paper in this series, which expands to a "seasonal brews and specialty brews" table of comparative analyses.

Our *Wicked Strawberry Blonde* is a specialty brew, and the inclusion of natural strawberry flavor late

into the preparation delivers its signature strawberry aroma and a gentle taste of the fruit in the beer.

The reader is invited to explore the brewing process, which is found in the downloadable Oktoberfest chapter of this eBook.

Although this particular paper does not include a table of analyses, we shall take the opportunity here to explain more about the analyses which we use and present.

Please understand that we wear our analytical data on our shoulder. Download the chapters in this eBook, and look at the tables, and you will find the Strawberry Blonde analyticals…along with 270 other beers in total. It would have been very easy to just detail information on many beers, and not share our analyses…but we really are in two different spheres at Pete's at the same time…we have a lot of good fun, but we also are proud of our great brews. And…we are the brewers that bring you comprehensive data on our products, as well as many good competitors. It is our hope that the reader who really wants to put brews under the microscope finds our contribution beneficial.

Analytical definitions

Sometimes, it's a bit easier to get a smart friend to assist you instead of reinventing the wheel. Chemical analyses of beer are like the blood running through our veins, but because the parameters are so 'second-nature' to us, it takes more effort to describe these explicitly.

Jim Hackbarth is a talented physical chemist, comfortable in the realm of applied statistics as well as in the analytical laboratory. After his graduate Physical Chemistry work and distinguished service to the US Air Force, Jim moved to Schlitz Brewing and then to Stroh…where he did remarkable work. This brewer has a special place for physical chemistry in his heart and an appreciation of the talents of physical chemists, having had the great privilege of a year's study under Prof. Gilbert Castellan, a renowned educator in the field. So I will relax with a *Wicked Strawberry Blonde* and share what my respected physical chemist friend offers (and add a couple of bits to it)….Jim's summary of the analytical parameters so important to our fraternity of technical brewers:

1. Specific Gravity & Degrees Plato. A solution's specific gravity (spg) is its density (*g/ml*) relative to water(*g/ml*) at 20 °C, and is measured with a hydrometer, pycnometer, or densitometer. Wort (unfermented beer) has a specific gravity greater than water due to the presence of sugars. Beer has a specific gravity less than its wort because some of the sugars have been fermented into alcohol. Professional brewers often use the **ºPlato** scale, instead of specific gravity, as a metric for the sugar levels in wort. The ºPlato of a solution is equivalent to its percent by weight of sucrose and has the dimensions *(g equiv. sucrose)/(100 g solution)*. Thus, a 1% sucrose solution is a 1 ºP solution. The relationship between Plato and specific gravity is nonlinear.

Table 1 of "Tables Related to Determinations on Wort, Beer, and Brewing Sugars and Syrups" published by the American Society of Brewing Chemists" in 1940 lists spg and Plato for sucrose solutions. The following least squares fit (from J. Hackbarth, Stroh Brewing Co.) for conversion from spg (or SpG) to °Plato replicates that table exactly.

$$°\text{Plato} = 2.58333 * (spg - 1) * 10^{2} - 2.14657 * (spg - 1)^{2} * 10^{2} - 1.9664 * (spg - 1)^{3} + 1.31634 * (spg - 1)^{4} * 10^{3} - 5.08755 * (spg - 1)^{5} * 10^{3} + 1.02848 * (spg - 1)^{6} * 10^{4} - 1.09709 * (spg - 1)^{7} * 10^{4} + 4.8248791 * (spg - 1)^{8} * 10^{3}$$

Wort gravity or °Plato is also referred to as the Original Gravity. So Original Gravity is a reference to the strength of sweet wort prior to fermentation.

Jaime's Note: It is easier to work with the Lincoln parametric equations published in the *Master Brewer's Association of the Americas Technical Quarterly* in 1987:

$$°\text{Plato} = \left[258-[205(spg - 1)]\right] (spg - 1)$$

2. Apparent Extract. Any measurement of specific gravity following fermentation that is converted to °Plato is called Apparent Extract. The apparent extract is based on a specific gravity that measures both extract and alcohol, and so cannot be the "real" extract. Since pure sucrose has a spg of 1.5552 and pure ethanol has a spg of 0.7907, **AE** has a theoretical range from 100 to –57.8. It is generally used to indicate that fermentation is complete since AE decreases as both extract is consumed and alcohol is produced.

3. Real Extract. The real extract is the % by weight extract in the beer, correcting for the presence of alcohol. The measurement is made by distilling off the alcohol and determining the spg of the reconstituted residue. That spg is then converted to °Plato and corrected for the alcohol as follows:

RE = (°Plato dealc beer) * (spg dealc beer)/(spg beer)

The Real Extract can be calculated from an empirically derived formula from Karl Balling, **RE** % by weight = 0.1808*ºP(initial) + 0.8192*ºP(final), Or from a combination of spg and refractometer, or spg and sound velocity or gas chromatography. By convention all these methods express the extract as if it were sucrose.

4. Alcohol. The measurement is made by distilling off the alcohol as in Real extract above, but then reconstituting the distillate portion to determine spg and then ethanol % w/w from table 2 of the ASBC tables. Given the Original Gravity and RE, several empirically derived formulas estimate the alcohol content. This one by Dr. Balling is based on the observation that fermentation of 2.0665 G of extract will produce 1 g of alcohol, 0.9565 g of CO2, and 0.11 g of yeast.

ABW (alcohol % by weight) = 100 * (RE - OG) / (1.0665 * OG - 206.65)

ABV (alcohol % by volume) = ABW*(spg beer)/0.7907

5. Original Gravity. The original gravity is equivalent to its percent by weight of sucrose and refers to the sweet wort prior to fermentation. OG can also be calculated from RE and ABW using the balling equation:

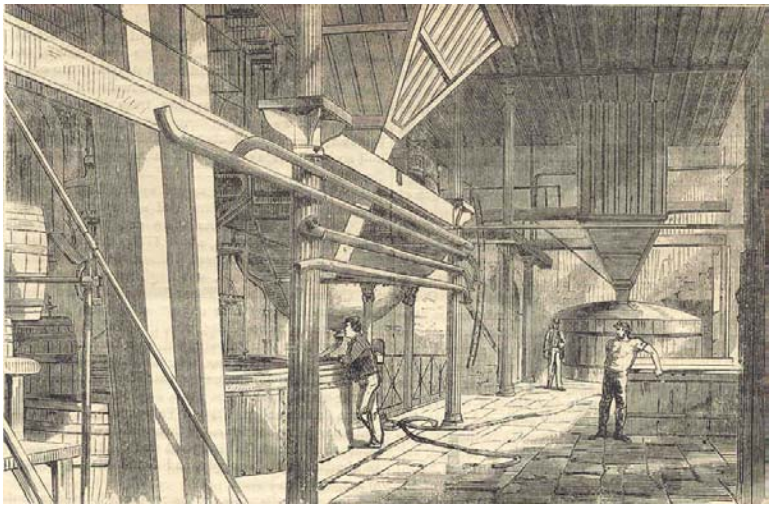
OG % by weight = 100 * (RE + 2.0665 * ABW) / (100 + 1.0665 * ABW)

6. Real Degree of Fermentation. Brewers measure the degree to which sugar in wort has been fermented into alcohol in beer with the term attenuation. A sweet beer has more residual sugar and lower attenuation. Like the calculation of extract there are several methods of expressing attenuation:

"Apparent Degree of Attenuation" ADA % = 100(1 - [ºP(final) / ºP(initial)])

"Real Degree of Attenuation" RDA % = 100(1 - [RE / ºP(initial)])

“Real Degree of Fermentation” RDF % =100*2.0665/(2.0665+RE/ABW)



ADA expresses how the apparent extract changes and does not account for the presence of alcohol. RDA expresses how the real extract changes but will change with the addition of water. %RDF expresses the % of extract that was fermented. Think in terms of Balling’s observation, fermented extract/total extract when 1 gram of alcohol is produced. %RDF’s in the 50’s represent full bodied beers with over 40 % of their original extract unfermented, while %RDF’s in the 80’s represent highly attenuated beers with less than 20 % of their original extract unfermented. Since RDF is a function of the RE/ABW ratio, some brewers just use the ratio which is less intuitive but just as robust. Mouthfeel is driven by %RDF…the higher %RDF, the lighter and drier the beer.

7. Calories. The number of Calories in beer can be calculated as follows:

Calories/12 fl oz beer = [6.9*ABW + 4.0*(RE – 0.1)]*SPG*3.55

This uses the known values of 6.9 cal/g for ethanol, 4.0 cal/g for carbohydrates, an empirical 0.1 ash portion of the extract, beer spg to convert from g to ml, and the scalar 3.55 to convert from 100 ml to 12 fl oz..

8. Color. Reported by ASBC method as degrees Standard Reference Method (SRM). Color originates from the malt and brewhouse operations.

9. pH. Negative logarithm base ten of the hydrogen ion Molar concentration. This is a measure of the beers acidity. Lower numbers being more acid. High or low numbers could indicate caustic or acid contamination from cleaning solutions.

10. BU. Bitterness units International Method. This is a measure of the hop bittering compounds or iso-alpha acids in ppm.

11. VDK. Vicinal Diketone or Diacetyl is a flavor active compound similar to butterscotch. High levels could indicate an incomplete fermentation or microbiological contamination. Measured in combination with 2,3 pentanedione by GC.

12. SO_2. Sulfur Dioxide is a naturally occurring antioxidant produced during fermentation. High levels could indicate yeast stress. Too cold a fermentation temperature, too low an oxygen load in the chilled wort, and other factors have been implicated. In a remarkable demonstration of brewing biochemistry deduction, Dr. D. Ryder of SABMiller has explained how an unusual route to high levels via inhibition of the enzyme sulfite reductase when the internal carbon dioxide pressure in a fermenter is too high:

- Acetaldehyde is normally reduced to ethanol
- SO_2 and acetaldehyde form an SO_2-carbonyl adduct…which cannot be reduced by yeast

- In package, beer gets oxidized to a sulfate and the carbonyl is released…aldehydes released create a paper flavor, *trans-2-nonenal*

13. Na. Sodium originates from the brewing water and the malt. High or moderate levels could indicate the use of syrup adjuncts. Adjunct syrups can be purchased which have undergone ion-exchange removal of concentrated salts…but none of these are used in our beers.

Conclusion and Related papers

We receive enough emails, and see enough questions on the USENET newsgroup rec.crafts.brewing, that we hope providing the detailed explanation of our analytical parameters offers answers to the questions, which the reader might have. The reader is encouraged to enjoy participation in beers newsgroups, too, such as in rec.food.drink.beer. USENET is like the 'cave paintings' of the Internet. Tempers flare at times, but often the discussion is germane and very interesting. A good newsreader allows the reader to take part.

Now please do open a fine *Pete's Wicked Strawberry Blonde* and download and enjoy the "Winter Brew" chapter in our e-book, as well as The "Ales" chapter, which shares rich historical information related to the effect on *Brettanomyces* as found in long-gone ales.

I'll be no more a nun, nun, nun
I'll be no more a nun!
But I'll be a wife,
And lead a merry life,
And brew good ale by the tun, tun, tun.

-Durham Alewife's rhyme, courtesy I. Peaty's *You Brew Good Ale*