Q&A from the October 19, 2018 ASBC Webinar: Raw Hop Quality Assurance—from Selection to Brew Kettle

https://www.asbcnet.org/lab/webinars/webinars/Pages/RawHopQualityAssurance.aspx

1. **The HSI standard was developed prior to anybody caring about aromatic qualities. Is anybody storing or pooling data around the aroma storage index?**

   To my knowledge, I do not know about anyone doing this, so I don't think that such an index currently exists. I know that in 1992 Gail B. Nickerson & Earl L. Van Engel published a paper where 22 compounds were used to create a Hop Aroma Component Profile (HACP) with constituents that could then be summed to create an Aroma Unit (AU) as a respective BU-type unit for brewing. I think this was done as an attempt at a universal potency measure rather than a rigorous study looking at how stable different hop varietal aromas are. To do this, I think that one could plausibly update this list of HACP's and look at how certain components within the list change per variety and then relate it to hop aroma quality and storability.

2. **Question about the quality shift during aging, would that be specific to the aromatic? i.e. myrcene seems to degrade into a negative while linalool levels might be increased.**

   I think this is a complex question, but in general, negative quality shifts can happen during aging that will decrease the apparent quality of the hop by either formation of off-flavors or degradation of positive flavors. In general, we will see losses of some important compound classes with storage such as terpene alcohols or thiols. We will also see increases in certain compounds like 3-methylbutyric acid that along with others will give the hops a cheesy and fatty aroma. We will also observe oxidation of major hydrocarbons like humulene and caryophyllene into their woody-flavored oxidation products. The implications for several of these changes on final beer quality will be highly dependent on when and how the hops are added. One example is how the acyl-side chain of bitter acids can be cleaved to release short chain monocarboxylic acids (like the aforementioned 3-methylbutyric acid) that can be converted to their respective ethyl esters (in this case ethyl-3-methylbutyrate) that impart pleasant fruity aromas.

3. **Are hop tea evaluations mostly aromatic or non bittering flavor?**

   Hop teas are mostly an aromatic assessment. The advantage is you have flavor extraction with a mimic of temperature and pH of beer. However, addition point matters so it will not directly represent brewing flavor.

4. **What are you using the FT-IR to test and what does sample prep look like?**

Alpha, beta acids – but Andrew can answer this more specifically. Just to add here. Yes, I am using the FT-IR to measure the alpha and beta acids in hops. It is a very simple sample prep that just consists of taking a representative sample of dry hops and then homogenizing them with a coffee grinder for approximately 30 seconds. The powder is then used to cover the surface of the ATR crystal, and pressed down with a standardized pressure arm. The whole process is fairly quick and takes less than 10 minutes to run a sample in triplicate. The instrument works off of a chemometric model and so the results can only be as accurate as the data we used to calibrate it.

5. **How closely does a loss in aroma track with increase in HSI?**

   Thinking not well – but Victor might have the latest research to cite here. I don't think that we have a universally accepted measurement of tracking loss in aroma analytically, so it would be hard to say with any certainty what correlations do or don't exist. I can imagine that there would be some relationship there, but that it would be very varietal-dependent. Here is a related publication to the subject: http://journal.asbcnet.org/pdfs/2017/ASBCJ-2017-1287-01.pdf . More research could be done to investigate this topic!

6. **Other than HSI, is there another (better) way to quantify hop oxidation?**

   Our recommendation is to use Sensory to evaluate aroma stability. It can be done as a hop rub, hop grind, or hop tea. The best way to quantify hop oxidation would be by measuring major aroma and bittering compound oxidation products directly (humulene epoxides, caryophyllene oxide, humulinones, hulupones). This quantification would require some GC-MS and LC expertise along with access to fairly pure standards. This currently is not a very feasible high-throughput quality metric and so sensory methods combined with measurements like HSI are still most practical.

7. **What is common density or desired density of the hop pellet?**

   Pellet typically range from 450-600 g/L in density. The density of a pellet depends on the hop variety. Also, manufacturer-processing parameters have a significant impact on pellet density and quality. There is debate amongst manufacturers around the most *desirable* pellet density (g/L); however, we believe that lower density pellets are higher quality and have better dissolution properties in wort and beer. This is especially important in dry hopping applications, where denser pellets take longer to hydrate, and in extreme cases the pellets never fully hydrate and stay at the bottom of the fermenter.