

# Hop Harvest Experiment

Using Descriptive Sensory Analysis  
and Consumer Overall Liking to  
Better Understand Hop Harvest  
Timing

Roy Desrochers  
Sensory Practice Leader  
May 2020

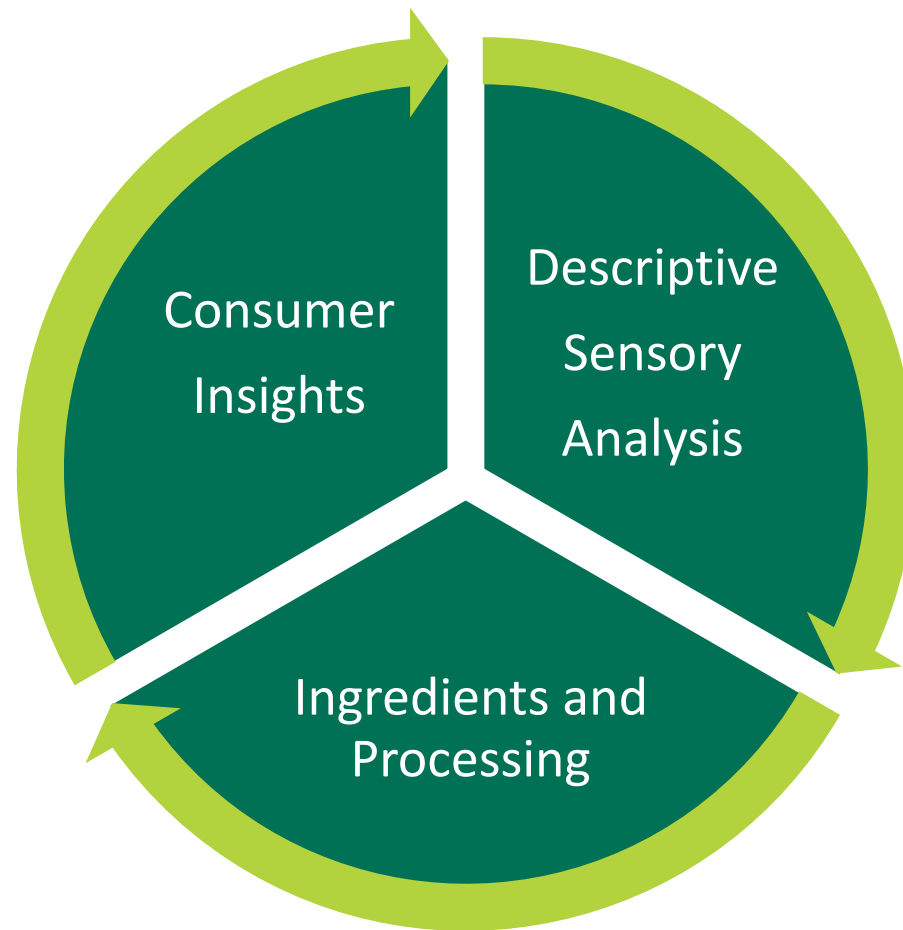


THE UNIVERSITY OF VERMONT  
**EXTENSION**

*Northwest Crops and Soils Program*

---

**Sensory-Directed Product Development is a powerful approach to connecting the dots between ingredients, processors, and consumer changing needs.**



---

**The overall objective of this hop experiment was to answer the question:**

“Does the timing of the hop harvest have a noticeable effect on beer flavor?”

**If we found noticeable effects, we hoped to use objective beer flavor data generated by trained tasters to interpret consumer overall liking scores and answer the questions,**

“What do the noticeable effects on beer flavor mean to the average beer drinker?”

“Will they care?”



---

## The Hop Experiment:

- Cascade hops (Commercial Cascade, 5.6%-8.8% Alpha Acids)
- Grown at the UVM hop yard
- Three harvest times, 1 week apart for a total of three weeks:
  - September 3, 2019 (Code: HD1)
  - September 10, 2019 (Code: HD2)
  - September 17, 2019 (Code: HD3)

The hop samples were provided to Switchback Brewing to be used in a standard beer recipe.



---

## Switchback Brewing used the three hop samples in separate brews using a standard India Pale Ale (IPA) recipe:

- Standard commercial malts:
  - Pale
  - Pilsner
  - Crystal (13-17)
  - Acid malt
- Bittering hops: Simone
- Gypsum and soft water
- Switchback ale yeast
- Cascade hop samples

The desired IBU's for this standard recipe was approximately 50.



---

**The staff at Switchback did an initial evaluation on the hop samples and recorded their impressions:**

- Browning increased across all the hop samples
- All of the hop samples had a “vegetative” characteristic
- The HD3 sample had a more intense “Cheesy” character

Although this type of aroma evaluation is often conducted on dry and wet hops, it rarely predicts what the hop aroma and flavor characteristics will be in the final beer.



---

## Switchback Brewery added the hops at three points in the brewing process:

- The wort in the hop kettle boil (bittering hops)
- The whirlpool after the boil (aroma and flavor hops)
- Secondary fermentation (dry hopping)

This type of hop addition is typical and is used to get the most out of the bittering hops during the boil while not driving off important aroma and flavor compounds present in the aroma hops by not allowing them to be in the boil for too long.



---

**We used two types of sensory methods to generate data to compare the three hop samples:**

- Descriptive sensory analysis (Objective data)
- Hedonic/Overall Liking (Subjective data)

We used these two types of methods to allow us to objectively describe differences in the flavor of the test brews due to the hops, and to interpret whether these differences were positive, or negative, for the average beer drinker.





---


















## The descriptive sensory analysis method we chose was Profile Attribute Analysis (PAA).

- PAA is a modification of the Flavor Profile Method, the original descriptive sensory analysis method, that was developed and introduced to the world by Arthur D. Little in the 1940s.
- PAA is both qualitative and quantitative:
  - A focused set of sensory attributes are developed based on reference standards
  - The sensory attributes are scored using a standard seven point intensity scale
- Sensory panelists are trained using reference standards for both intensity and standard terminology

The PAA sensory panelists are taught to measure each sensory attribute objectively by scoring its intensity with additional descriptive terminology, rather than rating how much they like, or dislike, the sample.



We used the following PAA scoresheet to objectively evaluate the test brews made with the three hop samples:

		SCALE								
ATTRIBUTES		1	2	3	4	5	6	7		
Balance	Unblended								Blended	
Fullness	Thin								Full	
Overall Hop Intensity	None								Strong	
Hop Complexity	Simple								Complex	
Citrus	None								Strong	
Floral	None								Strong	
Vegetable Sulfide	None								Strong	
Herbal, Spicy	None								Strong	
Cheesy	None								Strong	
Other Hop Character	None								Strong	
Grain Intensity	None								Strong	
Fermentation notes	None								Strong	
Sour	None								Strong	
Bitter	None								Strong	
Mouthfeel	None								Strong	
Others	None								Strong	
Aftertaste	None								Strong	

The samples were evaluated by a group of tasters at Switchback Brewing who had completed a sensory training session with Roy Desrochers to use this specific PAA scoresheet.



We used a standard nine point degrees of liking scale to generate the hedonic, or subjective data on how much people liked, or disliked the samples.



16 staff members at Switchback provided overall liking scores for each sample.

48 attendees of the hop conference provided overall liking scores for each sample.

Rather than use a numerical scale, which often leads to confusion, we used a graphic “happy face” scale to show that the middle point is neutral, to the right are degrees of liking, and to the left of center are degrees of dislike. This is a standard scale that allows us to overcome language barriers, as well as ensuring that everyone clearly knows where neutral is and which part of the scale is liking or disliking.



---

The two groups scored their overall liking of the three samples a little differently.

Sample	Switchback Avg. OL	Hop Attendees OL
HD1	4.8	5.5
HD2	5.0	4.6
HD3	3.6	4.9

We know from experience that it takes at least a 0.5 unit difference on average overall liking scores for the difference to be meaningful to beer drinkers and affect their purchase and consumption behavior. In some cases we find smaller but statistically significant differences that beer drinkers might experience, but they don't care or react.



---

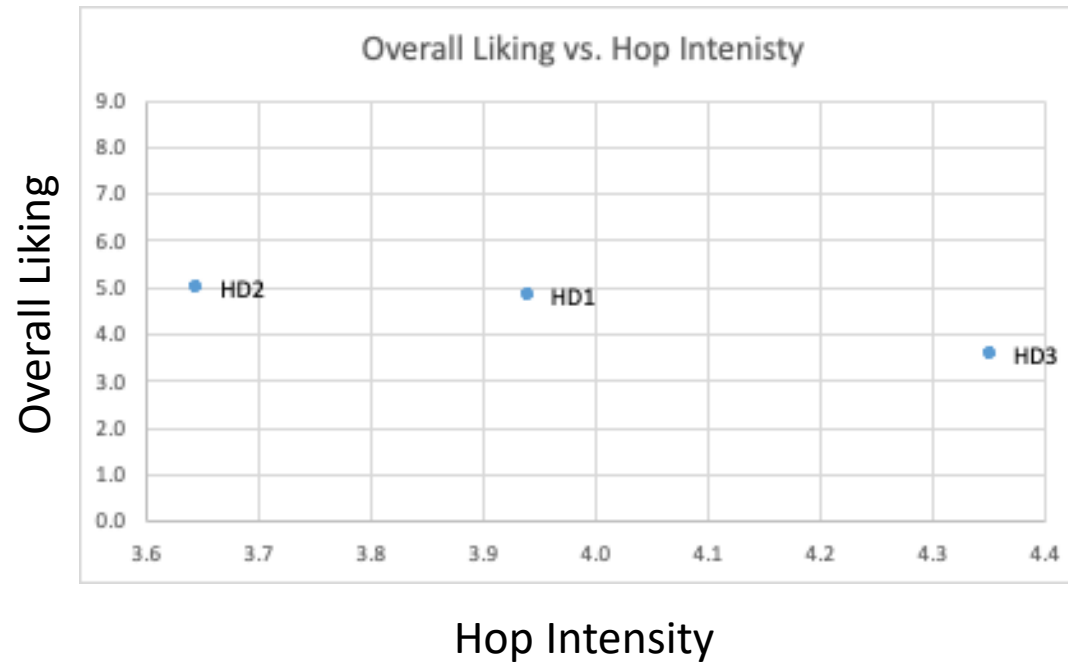
## What does the overall liking data from the two groups tell us?

- The attendees at the conference liked the first harvested hop sample more than the trained tasters at Switchback
- The attendees at the conference liked the first harvested hop sample more than the second and third harvested hop samples
- The trained tasters at Switchback disliked the third harvested hop sample more than the first two, and were more critical of it than the attendees at the conference

These overall liking results indicate the risk of using hedonic scores from trained tasters as they have more knowledge of the product and are trained to look for differences.



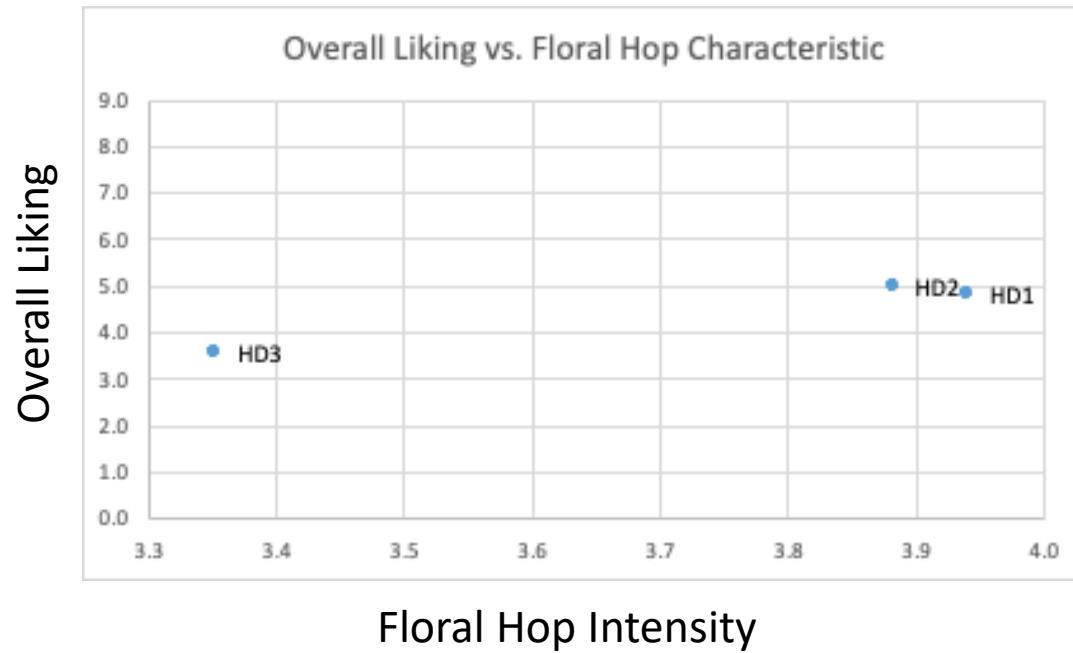
The objective PAA data gives us insight into why the third harvested sample was less liked.



We know that it takes a 0.5 unit or more difference in intensity to have meaning to a beer drinker. In this case, sample 3 had a higher hop intensity than samples 1 and 2 and we would expect beer drinkers to notice, and respond one way or another.



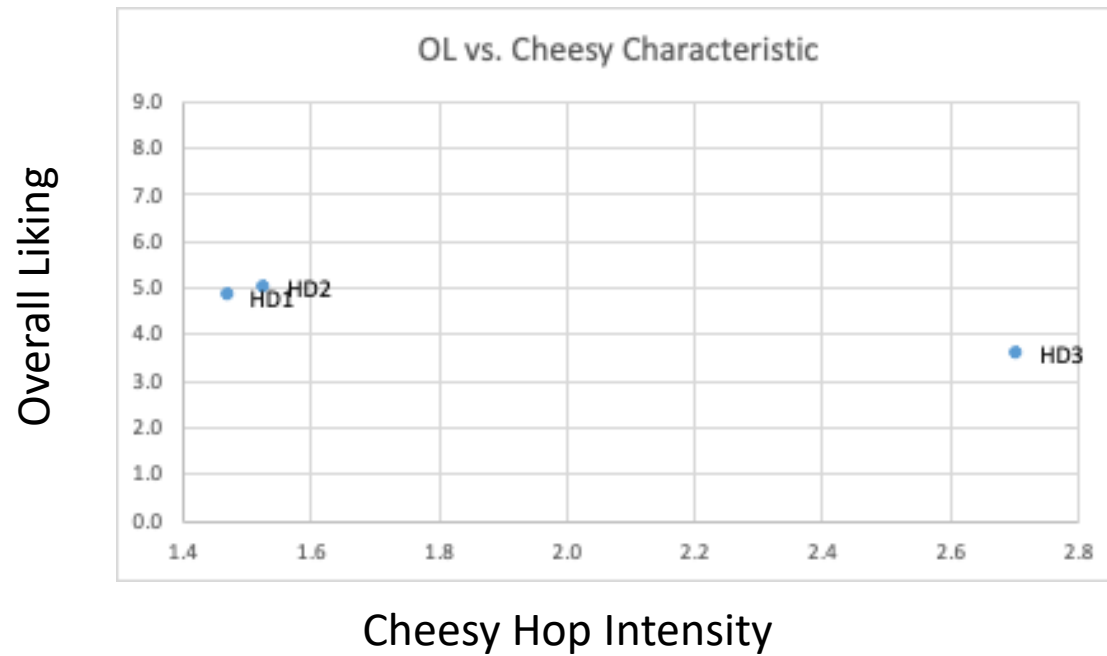
The objective PAA data gives us insight into why the third harvested sample was less liked.



The floral hop character was less intense in sample 3 than samples 1 and 2.



The objective PAA data gives us insight into why the third harvested sample was less liked.

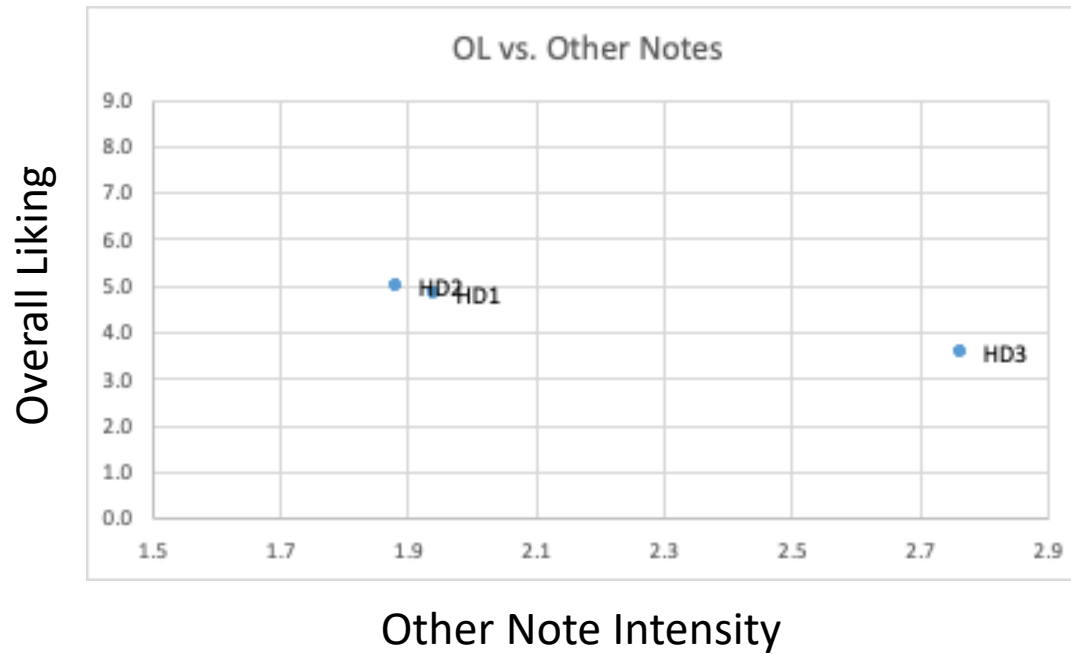


The cheesy character of sample 3 was more intense than in samples 1 and 2.





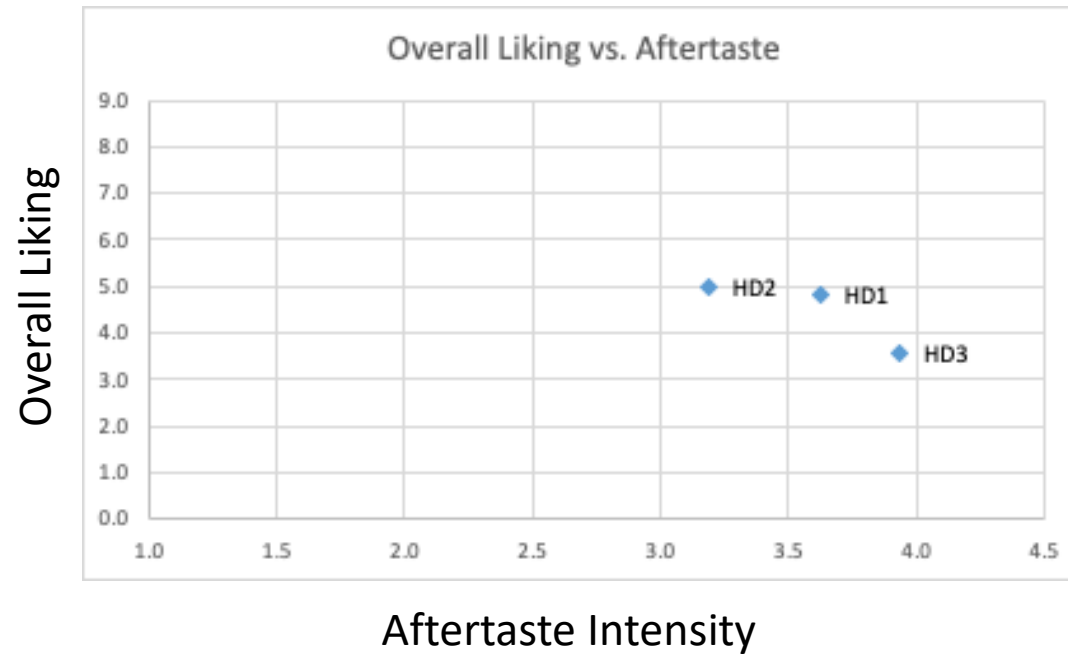
The objective PAA data gives us insight into why the third harvested sample was less liked.



Off flavors are one of the five flavor leadership criteria. Sample 3 had a more intense off flavor than samples 1 and 2, and we would expect beer drinkers to react negatively.



The objective PAA data gives us insight into why the third harvested sample was less liked.



Aftertaste is also one of the five flavor leadership criteria. Sample 3 had a stronger aftertaste than sample number 2.



---

## Conclusions:

- Average beer drinkers can detect a meaningful difference in beers made with hops harvested at different times.
- In this study, beer drinkers liked the beer brewed with the last harvested hop sample less than those harvested earlier.
- Consistent with our previous knowledge, beer drinkers in this study liked beer more that had less aftertaste and less off flavors. In addition, they liked floral hop character more than cheesy character.
- Trained tasters are more discriminating than untrained beer drinkers and caution should be exercised when using them to generate subjective/hedonic data.



---

**This study provided significant insights into how the harvest time of the hops can have a meaningful impact on the final beer flavor. It is a great start, but there is much work yet to be done. This experiment should be repeated and:**

- Increase the intervals of hop harvest
- Use other varieties of hops
- Brew other styles of beer with the hop samples, both hop-lead and neutral
- Increase the number of beer drinkers tested
- Use innovative consumer insight methods such as the Product Attribute Elicitation Method (PEM) to further understand why beer drinkers like or dislike the flavor of beer samples made with the hops
- Conduct flavor profile on the samples in addition to PAA
- Evaluate the dry hop samples using modified flavor profile
- Correlate chemical profiles with PAA results



---

**In addition to the important results yielded in this study, there were numerous benefits to brewers and beer drinkers through knowledge transfer.**

- The staff at Switchback were educated on the importance of flavor quality and what it means to their customers. They were also trained to use a descriptive sensory analysis scoresheet that will enable them to compare beer samples objectively in the future. Lastly, they were instructed in how to translate results and determine which differences matter to their customers. This will help them focus their efforts even more on what beer drinkers want and need in beer flavor.
- The bigger segment of hopsters and brewers were educated in the sensory workshop on standard terminology and intensity. They also learned about the importance of flavor quality and what it means. They will benefit from the results of this study and understand the importance of hop harvest time. Lastly, they will carry this knowledge to their peers in the hop and brewing industries.

