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Incorporating Hop Flavoring into a Retail Cider

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Abstract

Hard ciders accounted for only about 1% of the US beer market in 2014. However, cider sales are growing fast, increasing 75.4% from 2013 to 2014. It is estimated that cider and perry (pear equivalent to apple cider) sales will attain 785 million liters by 2018[1].

Craft brewers have been willing to creatively blend technologies to create new and exciting products. These technologies are also available to cider makers. This paper looks at incorporating hop derived ingredients and natural flavor substances to modify a commercially available cider to create new flavor profiles and provide cider makers with additional tools for making innovative products. The objective of this study is to use beer and flavor technology to modify the flavor profile of hard cider, and apply this technology to develop a prototype of new cider varieties.

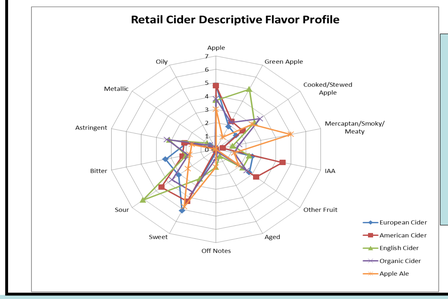
Down stream, post fermentation differentiation allows for breweries to diversify their offerings while not slowing down production. With the addition of hop extracts and natural flavors this can be achieved

This study takes a commercially available hard cider and transforms it using hop extracts, including hop bittering acid extracts and hop essential oil extracts, and natural flavors[2]. ANOVA analysis was run to confirm that there were statistical differences between samples from an undosed control and the test products.

The result of this work is the development of a new cider variety – the IP Apple, which encompasses the bold hop characteristics of an IPA and blends them with the sweet base of a hard apple cider. Using hop oils, hop acids, and flavor components, the flavor profile of apple cider can be manipulated to increase drinkability, add new hop derived flavors, and modify the apple character. The tools of creativity of today's craft brewers can be used for exciting new hard apple cider products.

Background

With the increased number of ingredients being used in the craft beer market, this project was designed to see if these same ingredients could be used in a retail cider to mimic craft beer and/or India Pale Ale flavor. We added hop acids, hop oils and flavorings after cider fermentation. A survey profile was completed by our trained internal hops panel to narrow down a suitable base to conduct this research.



The results of the sensory description of commercial ciders (unmodified) are depicted in the figure at left. There were significant differences between the various ciders. While they varied in sweetness and sourness, the only one with significant bitterness was a European cider, while some had a significant sulfur-derived flavor descriptor (mercaptan, smokey/meaty), other flavor descriptors were mostly different descriptions of fruity and apple flavors. Based on the results of this profile, the American cider was chosen for use in this study, for its mild background flavors and the ability to find it readily in the market. IAA refers to isoamyl acetate, which is considered to have a banana-type flavor but is found in many fruit flavors.

Methods

Samples were presented to the trained hops bitterness panel blind coded and randomized. Prior to each descriptive profile, the panel was asked to taste the samples and generate descriptors as a group. Each sample was evaluated individually by the panelists. The panel was asked to evaluate the samples based on the attributes listed in tables 1-4 based on a modified Universal Scale of 0 to 10 and bitterness on a scale of 0-100 Bitterness Units (BUs). A 2-way ANOVA was run using Senpaq™ software (Qi Statistics, Berkshire, UK). Attributes highlighted in red are statistically significant (α=0.05, P<0.05); attributes highlighted in yellow denote a trend towards significance and may contribute to aroma and flavor differences. Samples with the same superscripts are found to be not different from each other; samples with different superscripts are statistically different from each other.

Results and Discussion

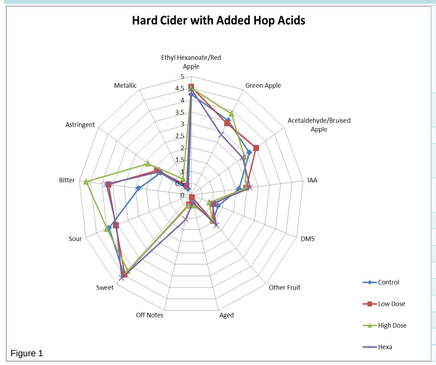


Figure 1

Table 1

Flavor Attribute	Undosed Hard Cider Control	Low Dosage Hop Acid Blend	Higher Dosage Hop Acid Blend	Hexa	P - value
Ethyl Hexanoate/Red Apple	4.23	4.55	4.50	4.45	0.7631
Green Apple	3.55^{ab}	3.41^{ab}	3.86^{a}	2.86^{b}	0.0465
Acetaldehyde/Bruised Apple	3.14	3.50	2.86	2.77	0.2784
isoAmyl Acetate (IAA) – Banana/Fruity	2.14	2.45	2.45	2.64	0.5483
Dimethyl Sulfide (DMS)	1.27	1.05	0.86	1.00	0.1070
Other Fruit	1.45	1.45	1.40	1.70	0.6555
Aged	0.37	0.10	0.45	0.32	0.0869
Off Notes	0.45	0.40	0.45	1.05	0.0595
Sweet	4.50	4.46	4.25	4.65	0.5087
Sour	3.91	3.58	4.00	3.55	0.5912
Bitter	2.35^{b}	3.70^{ab}	4.70^{a}	3.80^{ab}	0.0112
Astringent	1.65	1.83	2.33	1.72	0.1326
Metallic	0.28	0.44	0.78	0.39	0.3967

Figure 1 (top left) demonstrates how adding hop acids to the retail cider changes the apple characteristics of the base cider profile. The four treatments are: the control cider, a low level addition of a hop acid blend, a high level addition of the same blend, and hexahydroiso alpha acid (hexa). The low level hop acid blend increased the acetaldehyde/bruised apple characteristics while the higher dose hop oil blend as well as hexa addition reduced the acetaldehyde/bruised apple characteristics, although these changes were not statistically different. The higher dose blend also increased the green apple characteristics.

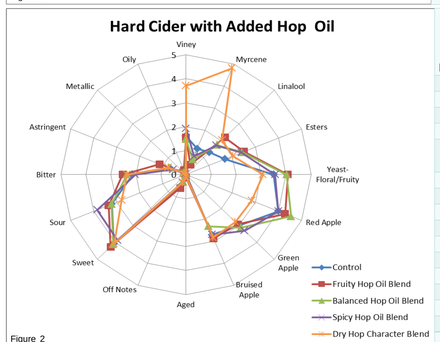


Figure 2

Table 2

Flavor Attribute	Control	Fruity Hop Oil Blend	Balanced Hop Oil Blend	Spicy Hop Oil Blend	Dry Hop Character Blend	P - value
Viney	1.61^{b}	1.56^{b}	1.48^{b}	1.93^{b}	3.71^{a}	<.0001
Myrcene	1.17^{b}	0.45^{b}	0.69^{b}	0.83^{b}	4.81^{a}	<.0001
Linalool	1.32^{b}	2.20^{a}	1.75^{ab}	1.72^{ab}	2.04^{ab}	0.0431
Esters	1.70^{a}	2.52^{a}	2.43^{a}	2.41^{a}	2.04^{a}	0.0379
Yeast-Floral/Fruity	3.51	4.07	4.03	3.57	3.07	0.0527
Red Apple	4.00^{a}	4.29^{a}	4.55^{a}	4.00^{a}	2.85^{b}	0.0007
Green Apple	3.00	2.93	3.12	3.30	2.79	0.8026
Bruised Apple	2.72	2.88	2.33	2.71	2.84	0.8011
Aged	0.00	0.13	0.00	0.00	0.08	0.5774
Off Notes	0.49	0.60	0.32	0.36	0.36	0.6856
Sweet	4.08	4.26	4.12	3.87	4.07	0.7268
Sour	3.21^{ab}	3.36^{ab}	3.22^{ab}	3.84^{a}	2.78^{b}	0.0540
Bitter	2.14	2.53	2.36	2.03	2.36	0.2363
Astringent	0.69	1.13	0.73	0.57	0.77	0.1496
Metallic	0.22	0.09	0.13	0.05	0.09	0.5811
Oily	0.00	0.21	0.08	0.00	0.00	0.5424

Figure 2 (bottom left) demonstrates the modifications made by the addition of hop oils. Various hop oil blends were added to the base cider. The addition of a dry hop oil blend showed the most dramatic changes to the base cider with increases in the viney and myrcene characteristics while reducing the red apple and sour characteristics of the base cider. The other blends tested made subtle modifications to the flavor profile of the base cider.

Figure 3 (top right) reveals the modifications to the apple characteristics of the base cider. Several varieties of apple flavors were testing to determine the most desirable apple characteristic modifications. The addition of the flavors modified the perceptions of apple characteristics (red, green, or bruised) and fruity perception such as IAA (banana), ionones (raspberry) and linalool (citrus).

Figure 4 (bottom right) demonstrates how the authors pulled all of the single components into a one piece blend to modify the base cider into an IPA style cider. The blend increased the myrcene, epoxides and estery characteristics of the cider as well as increasing bitterness, with subtle change to the apple profile. Anecdotally the authors felt that the bitterness increased the drinkability of the cider by balancing the sweetness.

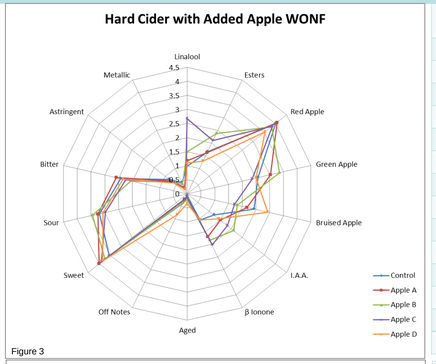


Figure 3

Table 3

Flavor Attribute	Control	Apple Flavor A	Apple Flavor B	Apple Flavor C	Apple Flavor D	P - value
Linalool	0.97^{b}	1.18^{b}	1.50^{b}	2.68^{a}	1.10^{b}	<.0001
Esters	1.65^{ab}	1.62^{ab}	2.38^{a}	2.10^{ab}	1.29^{b}	0.0101
Red Apple	4.00	4.07	3.82	3.86	3.54	0.7036
Green Apple	2.57	3.04	3.36	2.36	2.50	0.2134
Bruised Apple	2.43	2.18	1.82	1.71	2.93	0.1491
IAA	1.21	1.50	2.11	1.82	1.43	0.1068
β Ionone	1.03	1.70	1.84	2.03	1.03	0.0629
Aged	0.09	0.17	0.21	0.13	0.35	0.8362
Off Notes	0.38	0.24	0.36	0.21	0.83	0.0759
Sweet	3.55	4.01	3.74	3.89	3.85	0.2556
Sour	3.19	3.25	3.46	2.98	3.06	0.3956
Bitter	2.43	2.58	2.05	2.24	2.34	0.6270
Astringent	0.83	0.72	0.66	0.69	0.61	0.7723
Metallic	0.44	0.24	0.38	0.18	0.16	0.2462

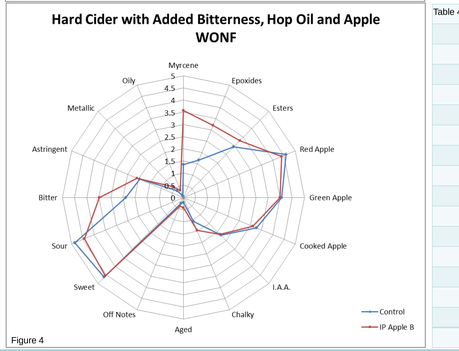


Figure 4

Table 4

Flavor Attribute	Control	IP Apple B	P - value
Myrcene	1.35	3.58	0.0009
Epoxides	1.67	3.20	0.0156
Esters	2.93	3.30	0.4451
Red Apple	4.60	4.40	0.6044
Green Apple	4.07	4.00	0.8916
Cooked Apple	3.27	3.10	0.5473
IAA	2.20	2.13	0.8576
Chalky	1.07	1.47	0.3860
Aged	0.21	0.42	0.3760
Off Notes	0.25	0.38	0.6742
Sweet	4.63	4.57	0.7090
Sour	4.86	4.43	0.2285
Bitter	2.39	3.48	0.0003
Astringent	1.96	2.08	0.6524
Metallic	0.38	0.62	0.0411
Oily	0.08	0.32	0.3305

Conclusions

Using hop oils, hop acids, and flavor chemicals, the flavor profile of apple cider can be manipulated to increase drinkability, add new hop derived flavors, and modify the apple flavor. New varieties of cider can be made, such as the IP Apple created for this paper. The tools of creativity of today's craft brewers can be used for exciting new hard apple cider products. This study shows how hop acids, hop oils, and flavors can be used post-fermentation as tools to modify the flavor of cider to improve or differentiate the flavor profile.

Special Thanks

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References

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2. McDonald, S., Schulze, M., Peltz, M., Bolliet, D., and Burroughs, L., 2011. Novel non-beer flavor applications of hop oil fractions. Perfumer & Flavorist. 36 (7) pp 24-31.