188

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Tasting Terroir: Sensory and Alcohol Analysis of Locally Isolated Wild Yeast

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ABSTRACT

Growth of new microbreweries in the United States has rapidly increased over the last decade. According to the latest statistics from the Brewers Association, 2013-2014 experienced a 27.8% increase in new U.S. microbreweries. In our state, New York, there has been a 141% increase in breweries from 2011-2014. This growth in number has caused increased competition and a desire to differentiate product within the crowded market. The vast number of different recipes and varying styles produced has driven the craft brew excitement and market accessibility. While many new recipes focus on variations of grains, malt extracts and hops, our lab concentrated on the yeast and specifically, wild yeasts. Previous studies in our laboratory have focused on the isolation, identification and characterization of local wild yeast strains from a nearby orchard for possible use in food production. This study continued and expanded upon that work to determine if the wild yeast were capable of producing quality craft beer. Side-by-side sensory taste analysis and alcohol yields were performed using both commercial and wild yeast strains and four different brewing recipes. Successful taste and alcohol yield with locally obtained wild yeast may represent a desired end product that consumers can enjoy and that producers can market uniquely.

INTRODUCTION

With the increase in popularity of craft beer over the last number of years, many microbreweries are trying everything they can to differentiate themselves from the competition. Although there are many different techniques that can be altered in the brewing process, such as ingredients, fermentation, time and temperature, *etc*. - the same basic brewing principles that have been used for over 5000 years are still in place today.

Wild yeasts were used for millennia in brewing and microbrewers are now re-discovering that flavors imparted by wild yeast generate unique brews unachievable by simply manipulating the ingredients alone. This experiment explored the fermentation and flavor profiles of brewing four different beer recipes with wild yeast strains, isolated from our own terroir. Data collected from this study could help microbrewers diversify flavor profiles by the manipulation of yeast alone.

MATERIALS AND METHODS

- ***Yeast Strains:*** Wild yeast were isolated from a locate apple orchard (**SEE POSTER 210**). Wild yeast designations include yeast isolated from Braeburn (BG), Macoun (MG and MT), Cortland (CG) and Jona Gold (JG) apples. Commercial yeast strains include American Wheat (1010, Wyeast) Munton's Standard Ale Brewing Yeast (Munton's), Irish Ale Yeast (WLP004, White Labs), HefewiezenYeast (WLP300, White Labs), German Wheat Yeast (1007, Wyeast) and Bavarian Wheat Yeast (3638, Wyeast).
- ***Brewing and Fermentation***: Each of the four recipe kits (American Wheat, American Pale Ale, Honey Brown, Dark Ale) were purchased from Homebrew Emporium, Rensselaer, NY. Each 5 gallon recipe was then divided equally into 1 gallon fermentation chambers and pitched with a different yeast strain. Pitching of yeast was kept at a constant cell number, 20 billion viable yeast cells, per fermenter.
- ***Culturing and Quantifying Yeast Cells:*** Yeast strains were subcultured on a bi-weekly basis on YGC agar (Yeast extract Glucose Chloramphenicol) and incubated at room temperature. Cell numbers were quantified and tested for viability using a standard hemocytometer protocol (1)
- **Platos and Alcohol by Weight Calculations:** To determine Platos using Specific Gravity the equation *plato = (-1 * 616.868) + (1111.14 * sg) – (630.272 * sg^2) + (135.997 * sg^3)* was used (2) For Alcohol by Weight (% ABW), the formula used was (ABW = [Original °P - Real Extract] / [2.0665 - (0.010665 × Original °P)] (3)
- **Sensory Analysis:** Sensory analysis was done with both novice and expert beer judges using a modified version of the BJCP Beer Scoresheet.(4) Eight sensory characteristics were selected and judged on a 1-5 Likert scale. Averages were calculated based off all judging scores (n=8). Scoring was done approximately a month after bottle conditioning. Radar charting was then used to graphically display the multivariate data.
- **Diacetyl Levels:** To determine the quality of the beer produced diacetyl levels were measured using two standard diacetyl test protocols, the force test and VDK spectrophotometer test. (5)

RESULTS

Alcohol Analysis

Figure #1: Estimated %ABW for Each Recipe and Yeast Combination. *Using a hydrometer Original °Plato and Apparent °Plato measurements were determined and used to estimate %ABW.*

Brewing Recipe	Yeast Strain	Original Extract (°Plato)	Apparent Extract (°Plato)	Approximate %ABW
Dark Ale	Munton's Ale Yeast	4.83	1.28	1.46%
3.3 lb Dark LME 1 lb Corn sugar 1 ½ oz Cascade 1 ¼ c of DME for priming	Irish Ale Yeast	4.83	0.51	1.77%
	Wild Yeast CG + MG	4.83	2.31	1.04%
	Wild Yeast BG	4.83	2.05	1.14%
American Standard	Munton's Ale Yeast	9.99	1.03	3.76%
3.3 lb LME 3 lb light DME 2 oz. Cascade 1¼c of DME for priming	Wild Yeast BG	9.99	0.51	3.96%
	Wild Yeast MT	9.99	0.51	3.96%
	Wild Yeast JG	9.99	0.51	3.96%
	Wild Yeast CG + MG	9.99	0.00	4.17%
American Wheat	Hefewiezen Yeast	11.56	2.81	3.76%
8 oz Malted Wheat 3.3 lbs Briess Wheat LME 3 lbs Wheat DM 2 oz Tettnang ¾ c of corn sugar for priming	German Wheat Yeast	11.56	3.32	3.32%
	Bavarian Wheat Yeast	11.56	6.32	2.09%
	Munton's Ale Yeast	11.56	3.83	3.23%
	Wild Yeast BG	11.56	5.08	2.60%
Honey Brown Ale	Munton's Ale Yeast	9.51	2.05	3.13%
8 oz Crystal 60 4 oz Black Patent 4oz Chocolate 3.3 lb Light LME 1 lb Light DME 1 lb Honey 2oz Willamette 1¼c of DME for priming	Irish Ale Yeast	9.51	2.56	2.92%
	Wild Yeast BG	9.51	6.32	1.36%
	Wild Yeast JG	9.51	2.05	3.13%
	Wild Yeast CG + MG	9.51	2.81	2.81%

Sensory Analysis

Figure #2: Analysis of 8 Sensory Characteristics for Each Recipe and Yeast Combination. Each individual recipe was tasted by a group of judges (n=8) during a single sitting. Conditions were held as constant as possible between each tasting.

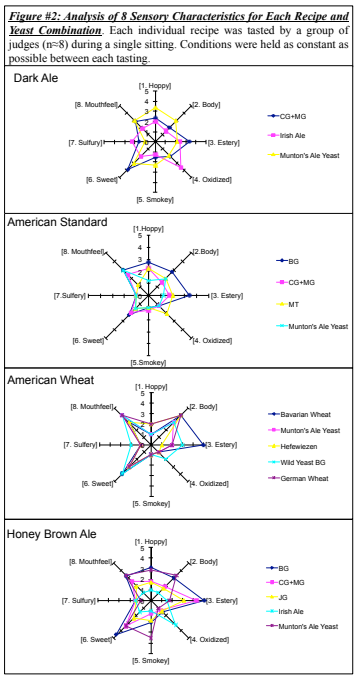

Figure #3: Diacetyl (2,3 butanedione) Sensory Force Test Analysis as a Measurement of Brewing Quality. Diacetyl production is always part of fermentation (yeast metabolism for amino acid production) but the residual amount can be used as a measurement of the quality of fermentation. Sensory analysis focused on identifying butter, caramel or butterscotch aromas after heating beer in a closed container at 65°C for 10-20 minutes. Conclusions were either none (no diacetyl or diacetyl precursors present), precursors only (needs more fermentation time) or diacetyl present (possible quality control issues). Only two recipes have been tested for diacetyl thus far, others will be tested in future studies.

Brewing Recipe	Yeast Strain	Room Temperature (21°C) Beer	Heated (60°C) Beer	Sensory Detection Conclusion	Diacetyl concentration (mM)
Dark Ale	Munton's Ale Yeast	-	-	None.	0.94
	Irish Ale Yeast	-	+	Precursors only.	1.69
	CM+MG Wild Yeast	-	+	Precursors only.	1.69
	BG- Wild Yeast	+	+	Diacetyl present.	1.55
Honey Brown Ale	Munton's Ale Yeast	-	-	None.	1.60
	Irish Ale Yeast	-	-	None.	2.07
	BG Wild Yeast	+	+	Diacetyl present.	2.14
	JG Wild Yeast	-	-	None.	2.07
	CG+MG Wild Yeast	-	+	Precursors only.	2.96

Figure #4: Spectrophotometer detection of Diacetyl Concentrations. To further determine the quantity, a diacetyl (0-4.8mM) standard curve was generated. Absorbance values at 530nm were read after colorometric detection reagents were added and plotted against the standard curve to determine the mM concentration.

CONCLUSIONS

Up to this point we have been able to create 20 different beers by using four different recipes and nine different yeast strains. In each beer recipe used, tastes dramatically different based on only the addition of different strains of yeast. Perhaps surprisingly our wild yeast strains held their own against some of the commercially-available strains. Through these studies we are just beginning to analyze some fermentation compounds and characteristics by using sensory analysis and chemical testing. Future studies will focus on a more complete analysis as we continue the comparison between our wild yeast strains.

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