Vineyard Age Effect on Juice Chemistry, Anthocyanins, and Total Phenolics

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Abstract

Grapevines (cv Zinfandel) planted in the same vineyard 100 years apart were analyzed for juice chemistry and phenolic content of the fruit. The vineyard was dry farmed, and vines from the original 1890 vineyard were compared to vines inter-planted in 1990. As “old vine” wines can command higher prices in the market due to a perceived difference in fruit characteristics. This study attempted to observe if there was a measurable difference in fruit characteristics, or if it is simply an effective marketing strategy. There has been little research conducted in the wine industry attempting to observe a difference of old vs young vines, and to the validity of marketing of “old vine” wines due to differences in fruit composition. Results from the study showed no significant difference in the analysis of fruit from vines planted in 1890 and vines planted in 1990 in regard to phenolic concentration, and juice chemistry. While it has proven to be an effective marketing strategy, these results do not validate the marketing of “old vine” wines based on being more concentrated or different in the variables measured in this study.

Introduction

Wines produced from grapes harvested from old vineyards are often labelled and marketed as “old vine” wines. This may be appealing to some consumers based on an emotional connection to the past, or because of a belief that old vineyards produce higher quality, or somehow different wines. There are no laws regulating the labelling of “old vine” wines in the US, which leaves room for interpretation as to what an old vine is. There are also few vineyards (such as the one in this study) that allows one to look at the same cultivar planted at different times side by side. This study aims to determine if grapes from vines planted in widely different years have the same concentrations of certain compounds in the grapes that could suggest why the resulting wines are perceived as different. If there is a significant difference between grapes from old vineyards vs young vineyards this may be observed with results of chemical analysis of the grapes.

Phenolics are found in the skins, seeds, and pulp of the grape and differ between cultivars used for winemaking (Van Leeuw et al. 2014). Phenolics in grapes account for a group of compounds that contribute to color, mouthfeel, and ageability of a wine (Sacchi et al. 2005). Juice chemistry also plays a vital role in wine character, and it is thought that cultivars of the same clone would produce the same amounts of compounds found in the grapes once mature. A significant difference between the parameters measured in this study could suggest that over time a vine changes the concentrations of certain compounds it produces in the fruit, or it may be due to disease or viral infection (Montero et al. 2016). This will be analyzed with data pertaining to phenolic compounds and juice chemistry gathered from vines planted at different times in the same location. Because differing amounts of light, heat, drought conditions, and other environmental stress factors can contribute to phenolic makeup (Teixeira et al. 2013) using the same vineyard block minimizes the effect of these factors.

What this study aims to observe is if the total phenolics, anthocyanins, and juice chemistry of grapes from vines of the same cultivar within the same vineyard planted in different years, changes overtime.

Materials and Methods

This study was conducted in 2017 at the Kunde Family Estate in Kenwood California, located in Sonoma County. Average rainfall in Kenwood is 32.2'' (818 mm) per year. Temperature has an average high of 73.7°F (22.94°C), and average low of 44.2°F (6.78°C). There are on average 2920 growing degree days (F°) in Sonoma Valley. The cultivar used for this study is Zinfandel (Shaw clone) planted on St. George rootstock. The vineyard block is 5 acres (2.02 hectares) and was originally planted around 1890 with a spacing of 12 ft X 12 ft (3.66 m X

3.66 m). Around 1990, vines of the same rootstock and cultivar were inter-planted between the original vines, creating a new spacing of 4 ft. X 12 ft. (1.22 m X 3.66 m). This vineyard block is head trained and spur pruned, has no trellising, is dry farmed, and has a south-west aspect.

For this study the year in which the vines were planted is the variable and there will be two treatments assessed, vines planted in 1890 and 1990. The treatments assigned will be randomized through obtaining samples from different vines planted in the same year. For this design the vines planted in 1990 will be viewed as the control. Samples were collected on September 16th 2017 two days prior to harvest. They were taken from six vines chosen at random, in one area of the vineyard to reduce sample variation that can be caused differences in soil physical and chemical properties (King et al. 2014). Six vines were sampled in total, three from vines planted in 1890 and three from 1990. Two basal clusters from different shoot positions were collected from each vine.

The analysis method carried out for anthocyanins and total phenolics follows the protocol of Iland et al. (2004). The berries were removed from the rachis, 50 were weighed and a mean berry weight was calculated. The samples were transferred into a 125 mL vessel and homogenized at or below 10°C to minimize oxidation using a Polytron CH-6010 homogenizer (Kinematica, Lucerne, Switzerland). Samples were homogenized at 24000 rpm until seeds and skins formed a homogeneous mixture. From the homogenized sample, 1 g was transferred to a pre-tared 15 mL centrifuge tube. 10 mL of 50% v/v aqueous ethanol, pH 2.0 was added and mixed for 1 hour using a TYZD-1111 orbital shaker (Kang Jian, Jiangsu, China). The tubes were then centrifuged for 5 minutes at 5000 rpm (Eppendorf, Hauppauge, New York). Once the supernatant was collected and the volume measured, 1 mL of each sample was added to 10 mL

of 1M HCl, and mixed thoroughly. The absorbance of the supernatant HCl mixture was taken after 3 hours at 700 nm, 520 nm, and 280 nm with a Cary 60 UV-vis spectrophotometer (Agilent Technologies, Santa Clara, California). Part of the calculations with this method is based on the use of the extinction coefficient of malvidin-3-glucoside. The remaining berries from each sample were then crushed, and allowed to soak for a period of one hour. The berries were then pressed to separate the juice from the skins and seeds and then filter and analyzed for °Brix, pH, titratable acidity (TA g/L), alpha amino acid (ppm), ammonia (ppm), and potassium (ppm) using an OenoFoss wine analyzer (Foss, Eden Prairie Minnesota). A two-sample t-test was used to analyze the data, and obtain p-values (JMP 2015).

Results

This study resulted in mean values for the 1890 treatment juice chemistry (Table 1) of 25.2 °Brix, pH 3.74, TA 5.34 g/L, alpha amino acid 78.99 ppm, ammonia 130.67 ppm, and potassium 2034 ppm. Treatment 1990 had mean values of 26.33 °Brix, pH 3.77, TA 6.17 g/L, alpha amino acid 149 ppm, and potassium 2256 ppm (Table 1). The phenolic measurements (Table 2) of treatment 1890 resulted in mean values of 1.64 mg of anthocyanin per berry, 0.79 mg of anthocyanin per gram berry weight, 0.22 absorbance units per berry, and total phenolics per gram berry weight of 0.11. Mean values for treatment 1990 resulted in 1.30 mg of anthocyanin per berry, 0.69 mg anthocyanin per gram berry weight, 0.22 absorbance units per berry weight, and total phenolics per gram berry weight of 0.10 (Table 2). T-tests of the juice chemistry and phenolic data indicates no significant difference between the treatments for any of the variables. These results show that vines planted 100 years apart with the same cultivar and rootstock do not produce different amounts of these variables in the fruit. Even with no

significant difference shown between the variables measured between the treatments, the mean values of all of the juice chemistry variables (Table 1) were slightly lower for treatment 1890, but were slightly higher for anthocyanins and total phenolics (Table 2). A trend that suggests that statistically significant differences might be found if a greater sample size were used.

Table 1
Mean values and standard errors for juice chemistry

Year	°Brix	pH	Titratable Acidity (g/L)	Alpha amino acid (ppm)	Ammonia (ppm)	Potassium (ppm)
1890	25.2 ± 1.46	3.74 ± 0.06	5.34 ± 0.33	78.99 ± 23.7	130.67 ± 20.85	2034.00 ± 89.63
1990	26.33 ± 0.94	3.77 ± 0.06	6.17 ± 0.17	88.27 ± 2.6	149.00 ± 6.35	2256.00 ± 153.24

Table 2
Mean values and standard errors for phenolics

Year	Anthocyanins per berry (mg)	Anthocyanins per gram berry weight (mg)	Absorbance units per berry (au)	Total phenolics per gram berry weight
1890	1.64 ± 0.16	0.79 ± 0.06	0.22 ± 0.0165	0.11 ± 0.004
1990	1.30 ± 0.23	0.69 ± 0.11	0.19 ± 0.0287	0.10 ± 0.013

Discussion

It is typical for producers of “old vine” wines to indicate that one reason why older vineyards produce different wines is due to more concentrated fruit, although to date there have been few if any published research papers found that suggest this. While this strategy of

product differentiation is an effective marketing technique (Fiore et al. 2017), the results of this study do not support the theory. This studies attempt at quantifying variables that contribute to fruit composition and concentration shows that marketing wines produced from old vineyards in this way is simply a marketing technique. A more valid explanation why an older vineyard could produce more concentrated fruit is a reduction in overall yield over time (Cortell et al. 2007). A continuation of this study gathering multiple years of data, with increased sample sizes would be ideal to observe if this trend continues. Further studies conducting fermentation trials and sensory analysis on the wines produced from this vineyard would give a look into if there are any significantly different sensory characteristics, or wine chemistry. Because there was no significant difference between the two treatments in this study it shows that this vineyard, based on the one year of this study, vines planted at different times with the same genetic plant material did not change the concentrations of these variables in its fruit.

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