Advance Journal of Food Science and Technology 16(SPL): 317-322, 2018
DOI:10.19026/ajfst.16.5974
ISSN: 2042-4868; e-ISSN: 2042-4876
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Submitted: September 29, 2017 Accepted: January 18, 2018 Published: November 10, 2018

Research Article

Evaluation of the Effect of Different Yeast Strains on the Quality of Blackberry Grape Wine (*Syzygium cumini* L. Skeels)

[1]Rafael E. Olivero, [1]Ángel, Eliecer J. Iglesias, [1]María J. Ariza, [1]Ramiro G. Torres and [2]Yelitza M. Aguas
[1]Universidad del Atlántico, Barranquilla Atlántico,
[2]Yelitza Aguas Mendoza, Universidad de Sucre, Sincelejo, Colombia

Abstract: The objective of this study was to evaluate the effect of different yeast strains (Lalvin 71B-112, Red Star Premier Cuvée, Red Star Montrachet) on the quality of blackberry grape wines. Blackberry grape (*Syzygium cumini* L. Skeels), as it is known in the Atlantic coast, grows with great abundance and on a wild basis in gardens, streets and avenues, but it is rarely used by this region's inhabitants. In the fermentation process, yeast strains were inoculated within three fermentation musts with the same physicochemical characteristics, cleared up with Bentonite (USP grade) and different parameters such as pH, alcohol levels, color, residual sulfur, appearance and sensory analysis were evaluated; then, the results were subjected to a statistical analysis with "Statgraphics1" and "Excel" to identify if there were significant differences amongst wine samples from the blackberry grapes. The results showed that the grape wine with the best characteristics was the one fermented with the Red Star yeast, which displayed superior quality with respect to the others. In the color evaluation, the % of red saw a decrease. The alcohol production that was obtained was influenced by the initial pH resulting in a characteristic degree of alcohol for this type of alcoholic beverage. It was determined that the optimum dose for the process of clearing in blackberry grape wine is 0.9 g/L of albumin since it complies with all the parameters established in the standard.

Keywords: Alcohol, clarifiers, color, fermentation, montrachet, sensory

INTRODUCTION

According to Petrova (2002), one way of helping agro-industrial development is by adding value to low commercial value raw materials such as tropical fruits. A viable alternative is to use fruits in the production of wines, low alcohol content beverages that generate high commercial interest, open new markets and increase economic benefits. Cassano also clarifies that such products reduce operating and production costs due to their stability at room temperature. Research on orange wine was done by some authors such as (Corazza *et al*., 2001; Fan *et al*., 2009; Ferreyra, 2006; Schvab, 2006; Selli *et al*., 2004; Stefani *et al*., 2014). All such works aim to show the development, improvement and characterization of the product through its biotechnological process as well as its instrumental and sensorial analysis; also, a lot of interest has been devoted to the process of clarification and its relationship with the aromatic fraction of wine as noted by Leal (2015) in his research work.

Despite the high level of wine consumption in Colombia, the nation's wine industry still has a long way to go and a lot to demonstrate, since, according to a report issued by the World Health Organization (WHO) in May 2014, the imbibement of wine is 1% of total alcohol consumption, a figure with little significance compared to 66% for beer and 33% for distilled spirits (Medina, 2014).

For a long time now, wine has been known as a drink made from grapes; this millenary drink that, undoubtedly, is the only one for which the name wine is commonly accepted. However, for alcoholic beverages made from other fruits are called by the word wine preceded by the name of the fruit, for example, apple, orange, passion fruit, etc., (López *et al*., 2002). It is of utmost importance to recognize, in this research, that fermented beverages made from fruits, or so-called "fruit wines" are made from various types of fruits: strawberry, pear, apple, mango, orange and other fruits (Berenguer *et al*., 2016).

Reportedly, the parent company (Prescue Isle Wine cellars) that sells the Lalvin 71B-1122 yeast produces fruity wines and can metabolize 15 to 20% malic acid during fermentation. This application is considered in wine where the obtainment of high acidity is desired (Salinas, 2007); likewise, Red Star Premier Cuvee yeast has good tolerance to ethanol and free sulfur dioxide and carries out fermentation to dryness. Premier Cuvée is observed as a very low producer of foam, urea and

Corresponding Author: Rafael E. Olivero, Universidad del Atlántico, Barranquilla Atlántico, Colombia
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fusel oils. It is recommended for red, white and especially champagne wines.

As Agudelo (2014), the growth of yeasts from the *Saccharomyces* genus is favored by the initial growth of others (Lage *et al*., 2014; Maturano *et al*., 2012; Medina *et al*., 2012; Torija *et al*., 2001). This genus is tolerant of high ethanol concentrations (Lage *et al*., 2014; Maturano *et al*., 2012) and low sugars. For this reason, it is present at the end of alcoholic fermentations in most studies conducted (Hidalgo *et al*., 2013).

According to several investigations and field trips made by Olivero, it has been observed that, in the city of Barranquilla, this plant grows with great abundance and on a wild basis in gardens, streets and avenues, but it is rarely used by the region's inhabitants, since it is seldom consumed in its fresh presentation with no processing being done to the product, which causes for total loss of the fruit during the harvesting season due to the fruit's short life, so it has become a "source of contamination" in times of production, because most fruits remain spread out on the ground fermenting quickly and leading to the proliferation of insects; due to this reason, the aim is to learn if it is possible to make high quality wine with the fruit thus providing it with an added value.

The blackberry grape (*Syzygium cumini* L. Skeels), is a perennial plant, which belongs to the family of *Mirtáceas*, originating from the tropics, particularly from India, where gardeners have reported a harvest of 700.0 fruits in 5-year-old trees with the production of one large tree being able to reach overwhelming levels for the average owner. The fruit also originates from Burma, Ceylon and the Andaman Islands, spreading to Colombia in the early nineties within a reforestation program promoted by the Ministry of Agriculture and executed by Umata (Monroy *et al*., 2013). This plant is reported to cause pollution. With this research, we aim at evaluating the effect of different yeast strains (Lalvin 71B-112, Red Starremier Cuvée, Red Star Montrachet) in the production of mulberry wine, (*Syzygium cumini* L. Skeels). The use of this type of fruit is of great importance by giving it an added value to produce wines with great acceptability and favorability due to their special scents and flavors in wine production; for this, physical-chemical and organoleptic properties must evaluate, which may project the acceptance or rejection in the eyes of potential consumers. In addition, the production of these wines, production costs are reduced due to the stability of the product at room temperature (Cassano *et al*., 2003).

MATERIALS AND METHODS

Obtainment and adaptation of raw material: Blackberry grape fruits were obtained from the urban zone of *Soledad* (Colombia, Atlántico), packed in 35.0×57.0 cm Ziploc plastic bags and subsequently sorted out according to their state of health, that is, those that do not show any bruises or unfavorable aspects, from the phytosanitary point of view, were selected. Once the fruits were harvested, they were cleaned and disinfected; this process was done by eliminating any physical contamination (twigs, leaves, etc.) and by carrying out the disinfection process with a sodium hypochlorite solution (NaOCl) at 15.0 ppm in order to eliminate surface bacteria, insecticide residue and dirt adhering to the fruits.

Fermentation of raw material and preparation of blackberry grape wine: Once the fruits were cleaned and disinfected, they were pulped. In this process, the blackberry grapes were run through a pulper and, thus, their juice was extracted, so that the juice would be exposed to the action of yeasts. Then, separation was made into three equal volumes inside fermentation tanks, proceeding immediately to the preparation of the fermentation must, where the yeasts selected according to criteria of tolerance to alcohol, resistance to Sodium Metabisulfite, fermentative capacity and its temperature range were activated. This process was performed by diluting yeast sachets (Lalvin 71B-112, Red Star Premier Cuvée, Red Star Montrachet), in water, each at room temperature inside an Erlenmeyer that was previously flamed by the edge, covered with a film of aluminum and then left to rest for 15 to 20 min. USP grade Sodium Metabisulfite was added to each fermentation tank in 3 stages:

- 75 ppm prior to alcoholic fermentation
- 75 ppm in the second transfer
- 50 ppm before bottling

Sugar correction or chaptalization: The purpose was to obtain a blackberry grape wine with an alcoholic degree between 9.5°-10.0° GL. For this, it was necessary to make a correction of the grades, whereby 1.5 kg of sucrose was needed to obtain a final level of 19.6 Brix corresponding to a blackberry grape wine with 10.0 GL, according to the calculations made by means of a material balance. Once the raw material or must was prepared and each yeast strain activated (Lalvin 71B-112, Red Star Premier Cuvée, Red Star Montrachet), these were inoculated into each fermentation tank labeled F1, F2, F3 respectively, as shown in Table 1. After inoculation, the prepared raw material was allowed to ferment at a temperature between 27.0 and 28.0°C for 10 days, since, after the eighth day, the °Brix remained constant and carbon

Table 1: Coding of samples with different yeasts

Nomenclature	Sample
F1	71B 112 lalvin
F2	Red star premier cuvée
F3	Red star montrachet

Table 2: Parameters and methods used in the analyzes

Parameter to be evaluated	Analysis to be used
pH	AOAC 960.19
Alcoholometric grades	AOAC 920.58
Color	Glories method
Residual sulfur	HOLC
Sensory panel	Professional taster
Percentage of yield	Equation (IFE)

dioxide emissions were almost nil. Once the fermentation was finished, 400.0 ppm of Potassium Sorbate was added to each fermentation tank to inactivate the action of the yeasts and for them to settle with the remains of the fruit, proteins, pectins, etc. These particles are called muddy sediments. The supernatant product was transferred to another fermenter and, after 5 days at rest, the second transfer was carried out and another dose of USP grade sodium metabisulfite was added carefully enough not to drag any sediments; finally, the clarification was performed by using USP grade bentonite. Twenty six point zero g of USP grade bentonite was used, which was slowly dissolved in water and added to the must after the second transfer.

Blackberry grape wine analysis: The physical-chemical and sensory analyzes are shown in Table 2. And the parameters and methods used are presented.

In this phase, the physical-chemical parameters of the three blackberry grape wine samples obtained were evaluated, including alcohol levels, pH, color, residual sulfur and percentage of yield according to the methodology shown in Table 2. Also, organoleptic characteristics of the final product were assessed by means of a professional wine taster in order to determine if the sensory features are characteristic as of those from a high quality red wine.

The statistical analyzes of the physical-chemical results obtained from each blackberry grape wine were made by means of "Stat graphics" and "Excel", by carrying out an analysis of variance and thus identifying if there were significant differences between the samples.

In the sensory analysis procedure, the presence of sommelier (expert taster) Gonzalo Cruz Montaña was necessary; Mr. Cruz was in charge of evaluating organoleptic parameters such as clarity, color tones, fluidity, first impression, olfactory intensity, aroma, olfactory attack, sapid sensation (sweetness, alcohol, acidity, tannin, body) and the wine's passage in the mouth.

RESULTS AND DISCUSSION

In the fermentation process, yeasts were gradually consumed the sugar available in the fermentation must and produced metabolites such as ethanol and carbon dioxide, mainly until sugar reaches a zero level, which entirely depends on the enzymatic capacity of the yeast to degrade the sugar. The must starts at 19.6° Brix and decreases as fermentation progresses to 6.1° Brix in the case of the F1 sample, 5.9° Brix in the case of the F2 sample and 6.5° Brix in the case of the F3 sample. In the previous result, there is a significant difference in the ability to ferment sucrose from the *Saccharomyces cerevisiae* 71B 112 Lalvin and *Saccharomyces bayanus* Premier Cuvee Red Star yeasts with respect to the *Saccharomyces cerevisiae* Montrachet Red Star yeast, all being in the same initial temperature, pH and °Brix conditions.

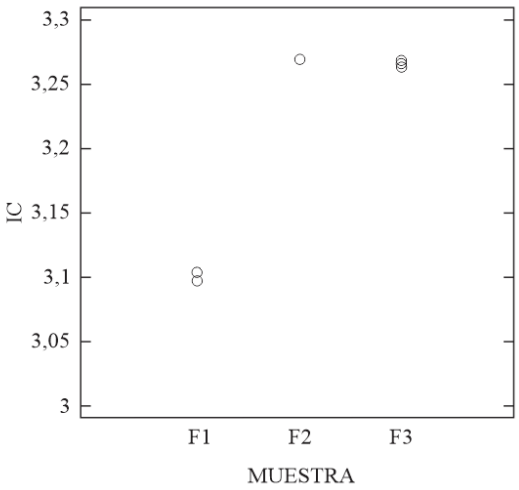

Fig. 1: Difference between Color Intensity (CI) levels

The analysis of pH variance shows that, there is no statistically significant difference between the median pH between one level of samples with 95.0% confidence. It is also observed that there are no significant differences with respect to the final brix degrees for each yeast used. Rodríguez's work in 2016 determines very similar values on acidity, determining through an analysis of variance that there is no significance between these variables: Variety, Yeast and Variety of yeast in mango wine.

Regarding the intensity of color, the highest value was obtained for the F3 sample, which corresponds to the blackberry grape wine fermented with Red Star Montrachet yeast and the lowest value came out of the F1sample fermented with the Lalvin 71B-112 yeast. The opposite happened with tonality, where the highest value was obtained from the F1sample, while F2 and F3 samples obtained the same value, as shown in Fig. 1.

With respect to yield, sample F3 showed 93.8%; this demonstrates that, in the other samples, F2 and F3, during the fermentation process, more muddy sediments were generated, which directly impacted the juice yield.

The sample of blackberry grape wine where most sulfur was obtained was in the F2 sample, which contains 37.8 mg/L and the sample that produced the most sodium metabisulfite oxidation was sample F3 with a final concentration of 29.6 mg/L (Fig. 2).

As a visual parameter, the clarity, tonality and fluidity of alcoholic beverages were evaluated by identifying each blackberry grape wine with the

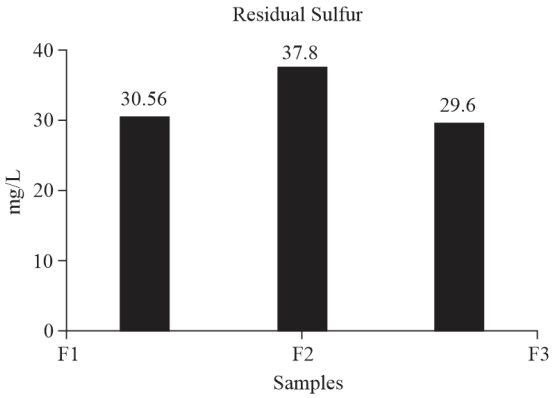

Fig. 2: Residual sulfur difference in blackberry grape wines

respective parameters. For the F1 sample (blackberry grape wine fermented with the *Saccharomyces cerevisiae* 71b 112 lalvin yeast), the characteristics of a bright blackberry grape wine showed, which was ruby red and very fluid; the F2 sample (blackberry grape wine fermented with *Saccharomyces bayanus* premier cuvee red star yeast), the characteristics of clean, red and ruby blackberry grape wine showed and the F3 sample (blackberry grape wine fermented with the *Saccharomyces bayanus* premier cuvee red star yeast) a crystalline limpidity, ruby red and viscous hue appeared as a parameter of fluidity.

As a gustatory parameter, the wine's taste attack and sapid sensation (sweetness, alcohol, acidity, tannin, body) were evaluated as well as the wine's passage in the mouth. As for the taste attack, it was evidenced that both the F1 and F3 samples had a taste attack on the mouth, unlike the F2 sample which showed an aftertaste attack. In a study carried out by Olivero *et al*. (2011), it was determined that orange wine with the K1-V1116 yeast is the best one evaluated by the panelists in terms of the total score on the UC Davis scale.

The sapid sensation was evident in the F1 sample as a sweet blackberry grape wine, with spirit-based alcohol, with high acidity, soft tannins and a thin body; in the F2 sample, the features were that of a blackberry grape wine with brut sweetness, sufficient alcohol, appreciable acidity, low tannins and full body; and in the F3 sample the features were that of a blackberry grape wine with dry sweetness, spirit-based alcohol, with excessive acidity, rough tannins and full body.

As a last gustatory analysis, the mouth passage parameter was evaluated, which showed that both theF1 and F3 samples were unctuous, unlike the F2 sample that was free-flowing. Rodríguez (2016), on mango wine, whereby the color, flavor, aroma, acidity and general acceptance were determined, as well as the quantitative measurement variables through an analysis of variance, alongside Duncan's multiple ranges with 5.0% of probability.

As an olfactory parameter, the first impression, the olfactory intensity and aroma of each blackberry grape wine was evaluated, with the latter being classified by the types of aromas, that is, primary (strain), secondary (fermentation) by identifying the three blackberry grape wines with an initial pleasant impression and primary fruity aroma; as for the olfactory intensity and secondary aroma, the F1 sample (blackberry grape wine fermented with the *Saccharomyces cerevisiae* 71B 112 lalvin yeast) came off as intense and lactic with reference to the secondary aroma; the F2 sample (blackberry grape wine fermented with the *Saccharomyces bayanus* premier cuvee red star yeast) displayed an average intensity and the secondary aroma was a sensation of alcohol; the F3 sample (blackberry grape wine fermented with the *Saccharomyces bayanus* premier cuvee red star yeast), came off as intense and with alcohols referring to the secondary aroma. Sensory evaluations of a similar product express that liquors of lower preference are the ones with the highest percentage of fruit. Panelists complemented the rating perceiving, according to their annotations, the following: liquors that presented a strong smell of fruit, high acidity and a lot of texture, viscosity, less body, less taste, as well as the fact that the bottom of the tasting glass or cup was not clearly appreciated (Mejía-Gutiérrez *et al*., 2015).

Regarding the perception of alcohol in wines, the taster sensed a perception of 12.0 to 14.0°GL in the F1 sample, from 14.0 to 16.0°GL in the F2 sample and of 13°GL in the F3 sample. With all the previous sensory analysis, the taster chose the wine from the F2 sample which was fermented with *Saccharomyces bayanus* premier cuvee red star as the wine with the best quality in terms of having more pleasant sensory characteristics and displaying a greater body than the others. Research by Mejía and collaborators in 2015 also determined that the highest alcohol production was obtained with 25.0% pulp.

CONCLUSION

The Lalvin 71B-112 yeast strain was the only one that had a different effect in terms of the color intensity of blackberry wine compared to the others, since it generated a lower coloring intensity, that is, the red color of the finished product turned out to be less "bright" because it contains more gray color in its composition. Regarding the hue of the blackberry grape wine, the *Saccharomyces bayanus* Premier cuvee Red Star yeast and *Saccharomyces cerevisiae* Montrachet Red Star yeast have the same effect in the fermentation must, while the wine fermented with the *Saccharomyces cerevisiae* 71B 112 Lalvin yeast presents significant difference with the other wines.

The best yeast strain for making blackberry wine is *Saccharomyces bayanus* Premier Cuvee Red Star, since the effects it had on the fermentation must generated the best quality wine compared to the other strains, as it generates a wine with greater body, more sensory pleasant and according to the results of spectrophotometry, along with the *Saccharomyces*

bayanus Premier cuvee Red Star strain, a more intense and bright red color was obtained than the F1 sample.

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