

Chemical Assessment of White Wine during Fermentation Process

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Bulletin UASVM Food Science and Technology 71(1) / 2014
ISSN-L 2344-2344; Print ISSN 2344-2344; Electronic ISSN 2344-5300

Abstract

There were investigated chemical properties of indigenous white wine varieties (Fetească albă, Fetească regală and Galbenă de Odobesti) during fermentation. The white wine making process took place at Wine Pilot Station of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. We aimed to monitor the evolution of fermentation process parameters (temperature, alcohol content, and real extract) and the quality of the bottled white wine (total acidity, alcohol content, total sulfur dioxide, total dry extract). The results obtained were in accordance to Romanian Legislation.

Keywords: *white wine, chemical parameters, fermentation process monitoring.*

INTRODUCTION

Wine includes a variety of compounds that influence its quality. These compounds originate from both raw materials and wine obtaining biotechnological processes. Alcoholic fermentation of white grape must, along with care treatments, conditioning and maturation applied have a direct influence on the physico-chemical and aroma compounds (Jones *et al.*, 2008; Komes *et al.*, 2007; Muñoz-González *et al.*, 2011; Suzzi *et al.*, 2012). Pérez-Coello *et al.* (2000) tested the fermentation of white wines in the presence of wood chips. Several studies had evaluated the impact of applied ageing techniques to white wines (Spillman *et al.*, 1997; Fernández-Navales *et al.*, 2009).

Romanian white wine comes from old times, reaching us through a dowry of native varieties (Fetească albă, Fetească regală, Grasă de Cotnari, Tămâioasă românească, Frâncușă de Cotnari, Galbenă de Odobesti), being the subject of different researches (Ghiță *et al.*, 2012; Itu *et al.*, 2011).

In the present study we aimed to evaluate the parameters evolution which influenced the white wines fermentation process of indigenous grape varieties (Fetească albă, Fetească regală, Galbenă

de Odobesti) at Wine Pilot Station of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca.

Feteasca alba is the most widespread variety in Romanian vineyards. The sugar content easily exceeds 200 g / L, but with low acidity. This deficiency has to be corrected in must processing, followed by low temperature fermentation. Fetească albă has not a great personality; it is a wine without a specific flavor variety, but is instead chosen a fine wine, round, soft, ample, full-bodied.

Feteasca regala is one of the most appreciated domestic grape varieties, native to Transilvania. The Fetească regala variety is an evolution Fetească albă; more specifically, it's a naturally occurring genetic evolution.

Grasa de Cotnari is an old vine variety from renowned vineyard Cotnari. It is considered that this variety is the most valuable in terms of quality, but has a relatively small area of culture. Grasa de Cotnari has thin and delicate skin; is very sensitive to attack by *Botrytis cinerea*. In warm and dry autumn the grapes touch easily sugars concentrations above 250 g / L; the wine obtained shows the specific character.

MATERIALS AND METHODS

Provenience of samples

Three indigenous white grape varieties were used in producing wine at University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca - Wine Pilot Station: Fetească Albă, Fetească Regală and Galbenă de Odobesti, from the Vrancea region, located in the South-East part of Romania.

Grapes reception involved quantitative and qualitative analysis (health control, sugar content and total acidity). In order to obtain the must, grapes were destemmed and crushed, then subjected to pressing. Skins and seeds were eliminated (*Fig. 1*).

Grape must was treated with sulfite and racked in tank. For clarifying, must was then cooled to 12 °C. The clarified grape must was transferred to the fermentation tank. Because of spontaneous flora present on the surface of grains, alcoholic fermentation started, grape must temperature rising to 16 °C. The must was inoculated with selected *Saccharomyces cerevisiae* starter culture

(15 g/hL). Grape must was then cooled, and the entire period of fermentation, temperature was maintained at 10 - 12 °C. The whole fermentation process was monitored by evaluating the following parameters: temperature, total acidity, apparent extract, total extract, alcohol content, relative density and sulfur dioxide.

The alcoholic fermentation was stopped (at total extract <4%) by sulfitation. After a resting period (with cold and protein stabilization), wine was racked in another tank and bentonized. Sulfitation was conducted in order to keep a maximum limit of 20 mg total SO₂/L wine (according to Romanian legislation). Double filtration was carried out (removing of fine particles and sterile filtration). The bottled wine was analyzed to establish the physical and chemical characteristics of the finished product.

Figure 1 describes the flow diagram of white wine making process.

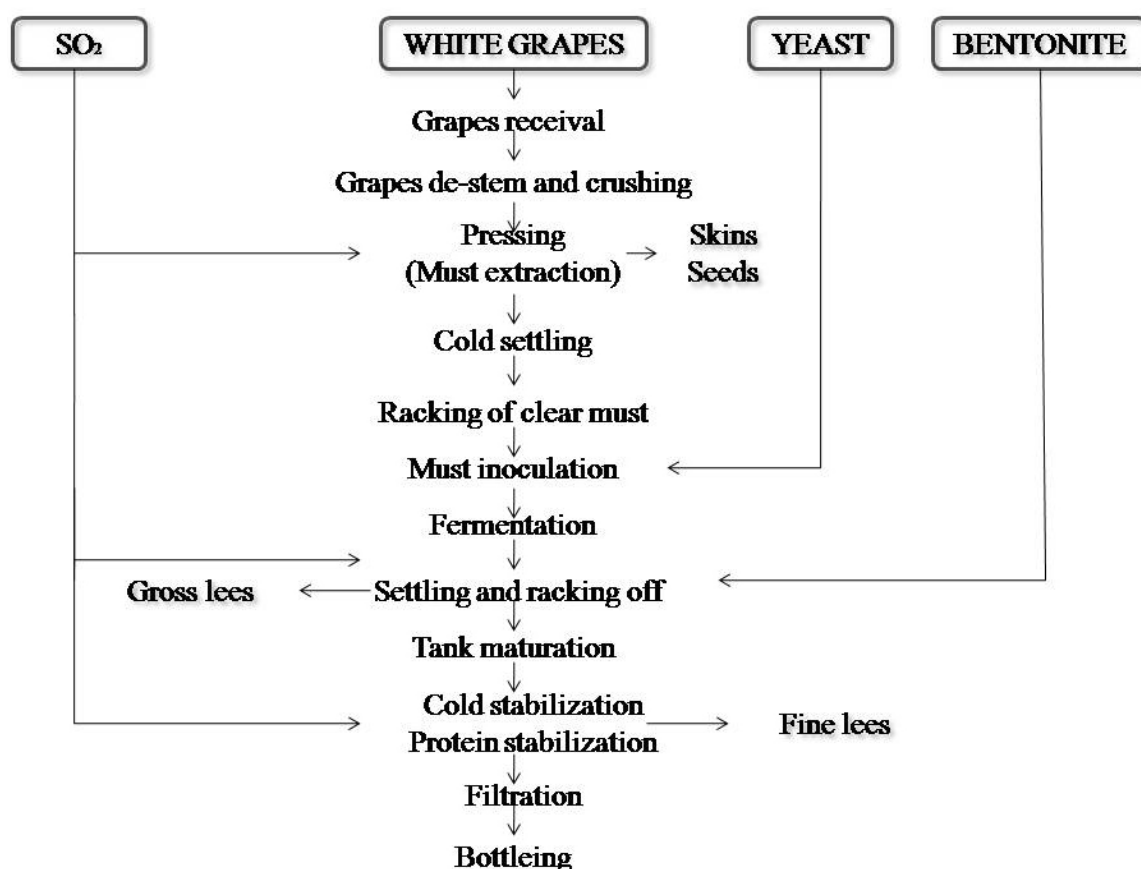


Fig. 1. Flow diagram of white wine making process

Description of the analyzed parameters

The alcohol content (expressed in % vol.) refers to the amount of ethanol produced from the grape must extract – fermentable saccharides - by the fermentation yeasts.

Must extract (original proof extract) - expressed in weight percentage (% wt) - represent the content of the solid substances found in original grape must at the beginning of the fermentation.

The real extract refers to the content of the dissolved substances in the de-carbonated grape must, expressed in % wt.

The apparent extract (% wt.) was determined in the presence of alcohol which influences it. Their value is smaller than the total extract and indicates the stage of fermentation.

The monitoring of the fermentation parameters

Analytical methods

Sugar content was determined at the reception of grapes using a digital refractometer type DR201-95 (Kruss, Germany) (STAS 6182/9-80).

Fermentation process was monitored by the evolution of alcohol content, original proof extract, relative density and temperature. Before each analyze, wine samples were filtered and freed of carbon dioxide by means of Erlenmeyer shaking flask.

Alcohol content, grape must extract (real and apparent extracts), and relative density were evaluated using the automatic analyzer Fermentostar (Funke-Gerber, Germany). This device is suitable for all types alcohol fermentation resulted beverages: alcohol content (0.00-15.00 % vol.); real extract (0.00-10.00 % wt.); apparent extract (0.00-10.00 % wt.); wort (0.00-20.00 %); relative density (0.95-1.05 g/cm³). The measurement is based on methods of thermo-

analytical measuring combined with mathematical algorithms. The accuracy of each measurement resolution defined by the manufacturer is 0.01 % for each parameter. The wine sample (20 ml), prepared as described before was sucked into a measuring cell by means of a pump. Alcoholic content, extract and relative density were measured using thermal measuring effects. Constituents thereby derived such as original wort and apparent extract were likewise determined. The result appeared on the apparatus screen.

All analyses were developed in order to verify their accordance with Romanian Legislation for wines (*Tab. 1*).

The measurement of pH was carried out using the pH meter type pH 315i (WTW GmbH, Weilheim). Temperature was measured using the thermometer set on the fermentation tank. Total sulfur dioxide and total acidity were measured by common titration methods. Total dry extract was determined using the refractometric method (STAS 6182/9-80).

Statistical analysis and evaluation of the results

All analytical measurements were performed in triplicate. The values of the parameters are expressed as the mean ± standard deviation. In order to evaluate the relation between variables, the Pearson correlation coefficient was used (Codină *et al.*, 2013).

RESULTS AND DISCUSSIONS

In the *Table 2* shown below are presented values determined at the reception of grapes.

The collected samples were tested by means of the automatic analyzer Fermentostar to determine the real extract, apparent extract, alcohol content and original proof of the grape must.

Table 1. Romanian legislation applied for wine quality parameters (alcohol content, total acidity, sulfur dioxide)

Quality parameter	Admissible value
Alcohol content, % vol.	Min. 8.5 Max. 15
Total acidity (H ₂ SO ₄ mg/L)	Min. 2.28
Sulfur dioxide, mg/L	
Dry red wines	Max. 150
Dry white and rose wines	Max. 210
Demi-dry white and rose wines	Max. 260

As seen in the *Table 3*, there were considerable variations during the period Day 5-25. These variations are related to the slightly fluctuations values of real extract, temperature and the period of fermentation. Values of the Day 24 represent the samples before filtering, and Day 25, the analysis taken on the bottled wine. Alcohol content in the bottled wine was 10.73 % vol. Very strong positive correlation was given between alcohol content and original proof extract ($r = 0.939$) and very strong negative correlation was determined between alcohol content - real extract ($r = - 0.999$), alcohol content - relative density ($r = - 0.997$) and alcohol content - apparent extract ($r = - 0.999$). The statistical analysis demonstrated the growing

dependence of the ethanol content on the extract concentration.

Besides these fermentation parameters, total sulfur dioxide and total dry extract were determined on the bottled wine (*Tab. 4*).

Our results were in accordance with previous studies (Nurgel *et al.*, 2002) and Romanian legislation (244/2002).

Table 2. Sugar content and total acidity as determined at fruit receipt

Parameter	Method	Value obtained
Sugar content, g/L	Refractometric	179
Total acidity (expressed in H ₂ SO ₄), g/L	Titration	4.06

Table 3. The mean values and standard deviation of the alcohol content, original proof extract, total extract, apparent extract and relative density in the fermented grape must samples taken from USAMV Cluj-Napoca - Wine Pilot Station

Parameter	Day 5	Day 10	Day 15	Day 17	Day 19	Day 20	Day 21	Day 24	Day 25
Alcohol content, vol.%	2.54 (±0.08)	2.14 (±0.07)	6.56 (±0.37)	7.71 (±0.21)	8.73 (±0.06)	9.35 (±0.08)	9.69 (±0.08)	11.00 (±0.28)	10.73 (±0.14)
Original proof extract, %	17.97 (±0.01)	17.94 (±0.05)	18.50 (±0.11)	18.70 (±0.08)	19.10 (±0.03)	19.33 (±0.00)	19.60 (±0.05)	20.38 (±0.21)	20.14 (±0.05)
Total extract, %	15.05 (±0.10)	15.47 (±0.11)	9.78 (±0.45)	7.93 (±0.29)	6.58 (±0.06)	5.65 (±0.21)	5.38 (±0.09)	3.66 (±0.32)	3.90 (±0.26)
Apparent extract, %	13.57 (±0.14)	14.20 (±0.15)	6.75 (±0.53)	4.78 (±0.30)	3.45 (±0.06)	2.65 (±0.16)	2.40 (±0.07)	1.19 (±0.19)	1.35 (±0.16)
Relative density, g/mL	1.0625 (±0.00)	1.0621 (±0.00)	1.0243 (±0.00)	1.0156 (±0.00)	1.0081 (±0.00)	1.0032 (±0.00)	1.0016 (±0.00)	0.9927 (±0.00)	0.9941 (±0.00)

Table 4. The values on the finished product (Day 25) - sulfur dioxide and total dry extract (g/L)

Parameter	Method	Value obtained
Total sulfur dioxide, g/L	Titration	133.12
Total dry extract, g/L	Refractometric	20.13
pH	pH meter	3.4

CONCLUSION

Three indigenous white grape varieties were used in making white wine at USAVM Cluj-Napoca - Wine Pilot Station (Fetească Albă, Fetească Regală and Galbenă de Odobești), from the Vrancea region, located in the South-East part of Romania. The technological process was monitorized in order to asses to evolution of the fermentation parameters (ethanol content, real extract and relative density) to obtain a white wine with specific parameters.

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