The influence of the climate variability on the main chemical compounds defining the quality of the viticulture production

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Abstract Geographical areas that are suitable for wine-growing include multifarious climatic region, relief and soils, which, correlated with variety and stock peculiarity, are determinative in order to obtain high quality grapes production and wines. The monitoring of the ecological offer has great importance, given the fact that by permanently knowing the condition of the viticultural ecosystems we could pass on to their rational and ecological use. The monitoring has the role of effectively finding any change that occurs in the area, offering the possibility to clarify the cause of the change, in order to adopt certain protective measures that allow the maintenance of a durable balance of the ecosystems in the area. The research studies established the reaction of grape vine to variable climatic conditions. Climatic changes lead to disturbance in the normal development of physiological and biochemical processes in plants, with great implication in quality and specificity of wine-growing and wine-making products. The effect of the varied climatic conditions on the Cabernet Sauvignon varieties was evaluated through the analysis of the chemical compounds: defining the quality of the viticulture productions: glucids, acidity, anthocyanins.

Key words grape vine, chemical compounds, quality, climate

Grapevines are multiannual plants, hence the significant importance of the influence of the annual ecological offer over production, especially its quality. The knowledge of influence of the climate variability on the main chemical compounds defining the quality is important for elaborating and supporting the viticultural technical activities. In order to perform durable viticulture, studies were made trying to identify the reaction mechanisms of grapevine under conditions of environmental stress; amongst the most representative at national at world levels are those made by the followings: Bessis R. and colab (1), Burzo I et all (2), Costea D.C., Daniela Doloris Cichi, (3,4,5,8), Genoiu E (6), Jouira Ben et colab (7), Olteanu I (8), Schultz, H. R (9,10), Tonietto J. (11)

Material and Methods

The research studies representing the object of the present paper were carried out for the Cabernet Sauvignon variety at the viticulture centre Segarcea during 2006-2008.

In accordance with the research topic proposed, the observations and determinations focused on:

- Comparative evaluation of pedological and climatic parameters implicated in accumulation of chemical compounds that defined the quality of grapes production.
- Study of the dynamics of several chemical compounds from grapes in proportion with climatic resources from investigated viticultural areas.
- Establish the influence of climatic variability on evolution of main chemical compounds, which define the quality of grapes production.

The recording of the climatic data was made in the existent meteorological network. For the characterization of the thermo-hydrich resources, climatic and synthetic indexes were used.

Results and Discussions

The complex evaluation of climatic resources, using unit and synthetic climatic indexes, clearly expresses very generous helio-thermic resources offer of Segarcea wine-growing centers, thus being ensured the quality and specificity of the wine-growing and wine-making products obtained in those areas (table 1,2,3). The values of oenoclimatic aptitude index in Segarcea wine-growing centers (values over 4600 for all studied years) attest the high favorable capacity of these areas to produce qualitative red wines. Comparative analysis of climatic data from the
three studied years relieves the state of 2007 and 2008 viticultural years, when the atypical values of climatic parameters had an important influence on ripeness dynamics, without prejudice to quality of grapes production; on the contrary, the quality increased, relieving the viticultural value of these areas. In 2007, it is worthy of note the high quantum of helio-thermic resources, but also the abundance of precipitations. During 2008 ripeness stage, a deep hydric deficit had been recorded. The effect of dryness had been enhanced by the temperatures recorded in august: average value of maxim temperature was 32.6°C. Segarcea area has higher higher values of effective balance of heat, average annual temperature, and number of days with temperatures more than 30°C, and more precipitations fall over a year or during period of vegetation process.

Table 1

The Progress of the Thermal Resources during Vegetation (1.IV.-30.IX.) Segarcea (2006-2008)

<table>
<thead>
<tr>
<th>year</th>
<th>Σ Tz. (°C)</th>
<th>Σ τ°g</th>
<th>Σ τ°a</th>
<th>Σ τ°u</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>347.3</td>
<td>530.0</td>
<td>593.0</td>
<td>663.9</td>
</tr>
<tr>
<td>2007</td>
<td>382.4</td>
<td>582.0</td>
<td>693.1</td>
<td>718.4</td>
</tr>
<tr>
<td>2008</td>
<td>365.8</td>
<td>523.8</td>
<td>640.4</td>
<td>705.6</td>
</tr>
</tbody>
</table>

Σ Tz. – the sum of daily average temperatures
Σ τ°g – the global thermal balance (°C)
Σ τ°a – the active thermal balance (°C)
Σ τ°u – the effective thermal balance (°C)

Table 2

The Sunshine Duration in the viticulture centre Segarcea (2006-2008)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>ΣIA (hours)</th>
<th>ΣIR (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>2272</td>
<td>1529</td>
</tr>
<tr>
<td>2007</td>
<td>2338</td>
<td>1628</td>
</tr>
<tr>
<td>2008</td>
<td>2101</td>
<td>1349</td>
</tr>
</tbody>
</table>

ΣIA= the annual sum of insolation hours
ΣIR= the sum of insolation hours during vegetation

Table 3

The Sum of Precipitations in the viticultural centre Segarcea (2006-2008)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>ΣA (mm)</th>
<th>ΣP.V. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>579</td>
<td>394</td>
</tr>
<tr>
<td>2007</td>
<td>821</td>
<td>436</td>
</tr>
<tr>
<td>2008</td>
<td>566</td>
<td>381,2</td>
</tr>
</tbody>
</table>

Table 4

The Evolution of Synthetic Climate Indexes in the viticultural centre Segarcea (2006-2008)

<table>
<thead>
<tr>
<th>Year</th>
<th>IHk</th>
<th>IH</th>
<th>CH</th>
<th>IAR</th>
<th>IHIR</th>
<th>IBCV</th>
<th>IF</th>
<th>IAOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>2.42</td>
<td>2262</td>
<td>1.17</td>
<td>27.3</td>
<td>5.42</td>
<td>7.13</td>
<td>11.8</td>
<td>4750</td>
</tr>
<tr>
<td>2007</td>
<td>3.01</td>
<td>2603</td>
<td>1.20</td>
<td>37.7</td>
<td>4.93</td>
<td>8.09</td>
<td>10.3</td>
<td>5083</td>
</tr>
<tr>
<td>2008</td>
<td>2.26</td>
<td>2405</td>
<td>1.11</td>
<td>25.9</td>
<td>2.94</td>
<td>7.48</td>
<td>11.0</td>
<td>4664</td>
</tr>
</tbody>
</table>

The analysis of vine development attests the dependence of chemical compounds from grape (glucides, anthocyanins, acides) on climatic resources – the relationship between these parameters is statistically sustained in proportion to unit and synthetic climatic indexes – and, also, on length and

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intensity of distinct climatic parameters during veraison and ripeness periods. Only helio-thermic resources influenced the amount of glucides, the variability of glucides accumulation process being the effect of variation of effective balance of heat, insolation amount and interaction of average temperature, maximum temperature and length of the day (Huglin index). Precipitations have no statistical sustained influence.

The values of total acidity amount are predominantly determined by the variability of effective balance of heat, and only in a small scale by variability of insolation quantum. The amount of precipitations has a small positive influence.

**Picture 1** – The effect of the effective thermal balance variability on the weight of 100 grape berries –a, on the content of glucids -b and acidity- c, for the Cabernet Sauvignon variety

**Picture 2** – The effect of the variability of the content of precipitations on the weight of 100 grape berries –a, on the content of glucids -b and acidity- c, for the Cabernet Sauvignon variety
The effect of the variability of insolation on the weight of 100 grape berries –a, on the content of glucids -b and acidity- c, for the Cabernet Sauvignon variety

The anthocyanins content reaches a high level at maturity and postmaturity moments for Cabernet Sauvignon During the 3 years of study

The grape berries’ content of anthocyanins vary depending on the main climatic factors (the effective thermal balance, quantum of precipitations and sunshine duration).

Under the climatic conditions during the 2006 grape maturation period the evolution of this category of chemical compounds has had a constant rhythm, reaching the maximum value of 1,394 mg / kg of Cabernet Sauvignon grape berries at their full maturity-

picture 4(2006). The high sunshine duration and the richness of thermal resources specific to the year 2007 have determined the
increased rhythm of this quality parameter, i.e. in early September Cabernet Sauvignon had a content of 1,398 mg / kg, slightly dropping to 1,347 mg/kg during the harvest maturity time– picture 4 (2007).

The same rapid growth of the content of anthocyanins was also obvious for the year 2008 when during 5 weeks only the level of this parameter increased from 598 mg/kg of grape berries to 1,390 mg/kg of grape berries for the Cabernet Sauvignon variety- picture 4 (2008).

**Conclusions**

The ecological offer, especially the temperature and hydric supply conditions, plays a major role in establishing the vineyards. The characterisation of the hydric supply conditions throughout a viticultural year can be made by using climatic indexes.

Under natural experimental conditions, the variability of the weight of 100 grape berries, as result of different climatic parameters, can be explained in proportion of 37.83% - 65.69% as result of the variability of the effective thermal balance; 37.33% - 63.66% as result of the variability of insolation.

The values of the total acidity have been determined in proportion of 72.67% - 93.32% by the variability of the effective thermal balance and only 16.63% - 68.33% by the variation of insolation.

This quality parameter has been positively influenced to a less extent (18.10%) by the variability of the quantum of precipitations in case of Cabernet Sauvignon.

During the 3 years of study, the heliothermal resources only have influenced the grape content of glucids. The quantum of precipitations has had a minor effect on this quantity parameter (12.68% - 24.69%). Significant proportions of the red colouring material expressed through the anthocyanin complex have been found in the Cabernet Sauvignon grapes both during full maturity as well as over maturity periods.

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