González Hernández, G.; Hardisson de la Torre, A.; Arias León, J. J.  
Colour and total phenols content in traditionally made red wine from the Tacoronte-Acentejo D.O.C. area (Canary Islands) 
Sociedad Mexicana de Nutrición y Tecnología de Alimentos  
Reynosa, México

Available in: http://www.redalyc.org/articulo.oa?id=72430404
COLOUR AND TOTAL PHENOLS CONTENT IN TRADITIONALLY MADE RED WINE FROM THE TACORONTE-ACENTEJO D.O.C. AREA (CANARY ISLANDS)

COLOR Y CONTENIDO DE POLIFENOLES EN EL VINO TRADICIONAL EN RAMA DEL ÁREA DE DENOMINACIÓN DE ORIGEN TACORONTE-ACENTEJO (ISLAS CANARIAS)

COR E CONTIDO DE POLIFENOIS NO VIÑO TRADICIONAL EN RAMA DA ÁREA DE DENOMINACIÓN DE ORIXE TACORONTE-ACENTEJO (ILLAS CANARIAS)

González Hernández, G.; Hardisson de la Torre, A.; Arias León, J. J.

Abstract

The present study determines wine colour and total polyphenol content in traditionally produced red wines (without final filtering and stabilisation) from the Tacoronte-Acentejo Designation of Origin Regulated area in Canary Islands (Spain). Different mathematical models were assayed in order to establish the linear relationship between certain physicochemical measurements. Therefore multiple correlation of colour against permanganate index, sulphur dioxide, and pH, and correlation of colour parameters with each other were studied. Thus, it can be used as a routine control for the qualification of the wine in order to know the ageing process. It was noticed that hue is the colour parameter best defined by the three variables examined. In regard to permanganate index, our results showed that 68% of must samples contain an equivalent amount of permanganate between 3.94 to 11.2 meq/L (milliequivalents per litre), with mean content in wines of 33.3 meq/L. There is not difference in the permanganate index between young and aged wine. © 2002 Altaga. All rights reserved.

Key words: phenol, colour, must, wine.

Resumen

Se estudia el color y el contenido de polifenoles en vinos en rama tradicionales procedentes de la Denominación de Origen Tacoronte-Acentejo de Canarias (España). Se aplican distintos modelos lineales para establecer la relación matemática que existe entre los parámetros que definen el color y el índice de permanganato, dióxido de azufre y pH; además de las correlaciones de los parámetros del color entre sí. Los resultados pueden ser utilizados como análisis de control rutinario para calificar el vino como joven o viejo, y conocer la evolución del envejecimiento. Se pudo observar que es la tonalidad del color el parámetro que mejor queda definido por las tres variables examinadas. Con respecto al índice de permanganato, el 68% de las muestras de mosto presentan una cantidad que oscila entre 3,94 y 11,2 meq/L (miliequivalentes por litro), con un contenido medio en los vinos de 33,3 meq/L, sin que exista diferencia entre vinos jóvenes y envejecidos. © 2002 Altaga. Todos los derechos reservados.

Palabras clave: Fenol, color, must, vino.

Resumo

Estudouse o cor e o contido en polifenolos nos viños en rama tradicionais procedentes da Denominación de Orixe Tacoronte-Acentejo de Canarias (España). Aplicáronse distintos modelos lineais para establecer a relación matemática que existe entre os parámetros que definen o cor e o índice de permanganato, dióxido de xofre e pH; ademais das correlacións dos parámetros do cor entre si. Os resultados poden ser utilizados como análise de control rutinario para calificar o viño como xoven ou vello, e coñecer a evolución do envellecemento. Puido observarse que é a tonalidade da cor o parámetro que mellor queda definido polas tres variables examinadas. Con respecto o índice de permanganato, o 68% das mostras de mosto presentan unha cantidade que varía entre 3,94 e 11,2 meq/L (miliequivalentes por litro), con un contido medio nos viños de 33,3 meq/L, sen que exista diferencia entre viños xóvenes e envellecidos. © 2002 Altaga. Tódolos dereitos reservados.
INTRODUCTION

Viticulture in the Canary Islands has three main features that distinguish it from that of the rest of the world. For one, *Phylloxera* is not present in this area, which means that the plant reproduces directly from the vine shoot, which is physiologically advantageous and allows the conservation of a large number of indigenous varieties in their purest form (López Arias et al., 1993). Also, the soil is of volcanic origin and is exceptionally rich in minerals. Moreover, temperatures are very mild (20°C a 25°C) because of the influence of *alísios* winds, i.e. the prevailing NE trade winds, and the Canary Islands’ oceanic current. Both phenomena modify temperatures throughout the year, making them milder than would be expected at this latitude (Marzol, 1990 & 2000; Rodríguez, 1973).

Traditionally made wines in the Canary Islands, which do not involve filtering and stabilisation comprise an important fraction of the total production in this region (86%) (López Arias et al., 1993). Since little is known about the total phenols content and colour of this type of wine, a study was conducted on some of the most representative wines. The area chosen was the Tacoronte-Acentejo area, whose wines have long been deservedly renowned and popular. This is the most important area of the archipelago in terms of volume of production and it is also one of the oldest of the wine-growing regions. With a total of 2,422 hectares planted Tacoronte-Acentejo is the Canaries’ largest and densest wine-growing area. The annual total wine output in the Canaries stands at 25.3 million litres, of which a mere 3.5 million litres are produced using state-of-the-art technologies (López Arias et al., 1993). The remaining 21.8 million litres are produced and sold in bulk in the myriad of small traditional wine-producing sites or wineries scattered throughout the various wine-growing regions (González, 1998). The geographical area studied lies on the coast on the northern side of Tenerife from 200 to 600-m above sea level.

Phenols influence the sensorial characteristics of wine (palatability, astringency and hardness); hygiene problems (vitamin P effect and bactericidal action) and the transformations undergone by wine (treatments and ageing). Moreover, since they originate in the solid parts of the cluster, skin and seeds, they account for all the differences between white and red wines (Ribereau-Gayon et al., 1980).

Recently, there is a considerable interest in the food industry and in preventive medicine in the development of “natural antioxidants” from plant material (Kanner et al., 1994) such as flavonoids (Rodríguez Lién et al., 1998; Vinson & Hontz, 1995). Their effects as captors of free radicals (Kovac et al., 1992), their influence on arteriosclerosis, and their anti-inflammatory and antiallergenic properties (Escrivan-Bailón et al., 1992; Kovac et al., 1992) have been recognised. Due to their action on free radicals, the potential anticarcinogenic properties of flavonoids are being studied (Hertog et al., 1993). The bulk of these compounds in the diet, at least in Mediterranean countries, come from grapes and wine (Escrivan-Bailón et al., 1992).

In food and beverages in general, particularly in wine, colour is an essential physical property in quality evaluation. Objective methods of determination for chromatic evaluation are necessary (Carrubba et al., 1985; Heredia et al., 1986). Phenol components, specifically anthocyanins, are the main cause of the typical violates red colour of red grapes, as well as of juices and wines obtained from them. Anthocyanins act as true acid-base indicators and their colour changes in the presence of sulphur dioxide and metals (Primo Yúfera, 1979). The red colour is a result of the amount of anthocyanins, directly, or by interaction with proteins, polysaccharides or other phenols (Robichaud & Noble, 1990).

The phenols content of wine depends on the grape variety, growing site, cultivation system, climate, soil type, harvesting time, production process and ageing, fundamentally (Brossaud et al., 1999; Mayén et al., 1995; Shahidi & Naczk, 1995). Nowadays, researchers determine usually the individual compounds (Malovaná et al., 2001; Pazourek et al., 2000; Rodríguez-Delgado et al., 2000). In this work total phenols content is studied, because of the whole family of this compounds, more than individual ones, are responsible of the sensorial characteristics above mentioned. The total phenol content reported in the literature, expressed in oxidizable matter (O.M.), is 20 meq/L to 40 meq/L in young red wine and up 50 meq/L in aged one. The amount is higher in winemaking with stems and increase parallel to ageing (Ribereau-Gayon & Peynaud, 1962). In the Canary region, fermentation takes place with all stems present, or with partial de-stemming. Nevertheless, Amerine and Ough (1976) suggested that those values were slightly high already at that time, and indicated that trends were the elaboration of wines smoother. Nowadays that is proved.

Seventy-five red wines from Tenerife were studied to know the evolution of total content of phenols and colour in regarding to ageing. On the other hand, this paper is continuing of the physical-chemical analysis of the studied wines. Sulphur dioxide (SO₂) and pH were determined using the reference methods of the European Community (EEC, 1990) (González Hernández, 1994; González et al., 1999).

MATERIAL AND METHODS

Samples

The present study was undertaken with samples of artisan red wine from the Tacoronte-Acentejo Denomination Area of Tenerife. The musts used to make red wine come from a mixture of red and white *Vitis vinifera* grape varieties, mixed in a ratio of 85% to 15%, respectively. The red grape varieties used were listán negro (60%), negramoll (20%), other indigenous varieties (5%), and the listán blanco white variety (15%). This is the approximate composition of the traditionally musts of this region (López Arias et al., 1993).

Once the grapes have been pressed, they then undergo a process of mashing-fermentation in large, shallow vats. The prolonged aeration of the musts accelerates the start of the fermentation process through ...
the rapid growth of the yeast. After 48 – 72 h, the solid material is pressed and the liquid is passed into chestnut tree barrels with a capacity of 400-600 L, where fermentation finishes. The wine is then kept in these same barrels to acquire its typical “cru”. One of the main features of this kind of wine is its high alcohol content (González Hernández et al., 1997).

Forty samples of must from 40 representative wineries in the area were collected during the harvesting time. Afterwards 40 samples of young red wine coming from these musts were collected in January, February, March and April, and 35 samples of the same wines were collected in June and July, after an average of 106-days ageing (five samples missing). In order to preserve stability during manipulation, toluene was added to the samples.

**Analytical Methods**

The amount of phenol substances (Permanganate Index, IMn) was determined through evaluation with KMnO$_4$ according to the following procedure (Ribereau-Gayon et al., 1980): 50 ml of 0.015% indigo carmine in 0.60 N sulphuric acid and 2 ml of wine or 1 ml must were placed in a measuring glass. The solution was then evaluated with KMnO$_4$, 10$^{-2}$ N. The same evaluation procedure was employed with 50 ml of the same sulphuric solution of indigo carmine, to which was added 2 ml of a tartaric solution of 5 g/l, partially neutralised and with 10% alcohol. The difference in MnO$_4^-$ volume is the amount expended by the phenol compounds. The analysis ran for duplicate.

Absorbance and transmittance measurements were taken using Perkin-Elmer 5505 and Perkin-Elmer Hitachi 200 spectrophotometers, equipped with quartz cells of 0.1, 0.2, 0.5 and 1 cm thickness, which were adequate to make dilution unnecessary. Absorbances were measured at 420, 520 and 620 nm; colouring intensity $I$ and hue $N$ are given by the expressions (EEC, 1990):

$$I = A_{420} + A_{520} + A_{620}$$

$$N = A_{420} / A_{520}$$

In order to obtain more precise information for a better definition of the colour of red wines of the studied zone, we used “three-stimuli”, or three-stimulate co-ordinates $X, Y, Z$ based on the system of the C.I.E. (Commission Internationale de l’Eclairage). $x, y, z$-chromaticity co-ordinates of the representative point of wine on the C.I.E. three-chromatic diagram, as well as the relative luminance $RL$, were calculated from the following expressions (OIV, 1990):

$$X = 0.42 \times T_{625} + 0.35 \times T_{550} + 0.21 \times T_{445}$$

$$Y = 0.20 \times T_{625} + 0.63 \times T_{550} + 0.17 \times T_{445}$$

$$Z = 0.24 \times T_{405} + 0.94 \times T_{455}$$

$$x = X / X + Y + Z$$

$$y = Y / X + Y + Z$$

$$RL = Y$$

Where $T$ is transmittance at the indicated wavelengths.

**Table 1**

<table>
<thead>
<tr>
<th></th>
<th>Must</th>
<th>Young wine</th>
<th>Aged wine</th>
<th>All wines</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>33</td>
<td>40</td>
<td>35</td>
<td>75</td>
</tr>
<tr>
<td>Mean value</td>
<td>7.58</td>
<td>33.3</td>
<td>33.3</td>
<td>33.3</td>
</tr>
<tr>
<td>S.D.</td>
<td>3.64</td>
<td>9.67</td>
<td>11.4</td>
<td>10.5</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.65</td>
<td>17.3</td>
<td>16.0</td>
<td>16.0</td>
</tr>
<tr>
<td>Maximum</td>
<td>15.9</td>
<td>61.7</td>
<td>74.5</td>
<td>74.5</td>
</tr>
<tr>
<td>V.C. %</td>
<td>48.0</td>
<td>29.1</td>
<td>34.4</td>
<td>31.4</td>
</tr>
</tbody>
</table>

**Statistical analysis**

The software package Statgraphics Plus 4.0 (INST, CA) was used for the statistical analysis. Linear and non-linear mathematical models were assayed to establish the relationship between certain physicochemical measurements.

**RESULTS AND DISCUSSION**

Table 1 gives a statistical description of IMn for the samples of musts and red wines studied. In musts, contents range between 0.650 and 15.9 meq/L. This wide range is thought to be due to the different environmental conditions of each winery, i.e., most samples present a detectable amount of matters which are susceptible of cold permanganate oxidation, notwithstanding the fact that they were collected immediately after grape crushing. Even though a mere 5% of total phenols come from the juice (Alonso et al., 1986). Content can be explained by a rapid dissolution from solid parts due to the rather slow crushing process, which leads to a period of intense contact between the juice and solid parts before sample collection (Alonso et al., 1986; Otero et al., 1986). 60% of must samples are observed to have values ranging between 4 and 11 meq/L O.M.

It should be noted that in approximately 40% of the samples studied sulphur dioxide had been added, a compound that has a synergy effect with o-dihydroxyphenols (Cela et al., 1982; Peris-Tortajada et al., 1989).

In the case of wines total phenol content was found to be on average 33.3 meq/L O.M., ranging from 16.0 to 74.5 meq/L. The results indicate a homogeneous distribution, with a variation coefficient of 31.4%. The figures for the studied wines in general are deduced to be rather low and they are classified as light wines by Ribereau-Gayon et al. (1980). One must also bear in mind the evolution of consumers’ taste towards milder wines (Muñoz Alcón & Mariné Font, 1978) and, consequently, the evolution of winemaking techniques towards shorter maceration periods. In any case, these values roughly coincide with those reported in the literature for Spanish wines from different parts (Gil & Gómez-Cordovés, 1985; Muñoz Alcón & Mariné Font, 1978). In accordance with Rodriguez et al. (1987) the wines studied by us fall into the category of common sweet wines, with contents slightly below the average of 40.4
In regard to the colour, Table 2 shows the results of colour defining parameters for the 75 samples of red wine studied. Analysis of results and comparison of young and aged wines show a decrease of 0.035 units in \(x\)-chromatic value, whereas the \(y\) value remains virtually the same.

Figure 1 shows the representation of chromaticity values on the CIE three-chromatic diagram (Lozano, 1979). It can be seen that the young wines are seen to have a number of colour points close to the most saturated red zone, i.e., with a pure hue. Other points lie in the pure reddish orange zone, shifting to the clearer red zone due to ageing and, lastly, are situated in the orange-pink zone. Numerically, this means that wine ageing involves a decrease in colour intensity, with lower \(x\) values. The presence of a group of samples with an \(x\)-chromaticity value of below 0.5 and which are closer to being colourless than to the characteristic red colour of red wine can also be detected. This is probably due to the heavy addition of \(SO_2\) in these samples (González et al., 1999).

Luminance values (\(Y\) %) increase with ageing. In the examined samples, 3-month ageing in wood barrels leads to as much as a 3.40 unit’s average increase. Colour intensity (I) for the wines from these vine ranges from 1.56 to 9.89, with a mean value of 4.01; ageing causes a decrease of approximately one unit. In regard to hue (N) a tendency towards an increase can be observed. In the three months of ageing, the value increases from 0.873 to 0.938 (for young and aged wines, respectively).

The most salient aspect is the high value of N (Table 2), in spite of the fact that they are young wines, usually drank within one year following production and, in most cases, within 6 months, when the mean hue value (young wine) is already 0.873. In our opinion, such high values are due to the widespread use of wooden barrels with a capacity for approximately 600 L. These permit excessive air contact, leading to considerable oxidation and, consequently, dark reddish hues improper of young wines are obtained.

In any case, the results obtained by us are of the same order of magnitude as those reported by Gil and Gómez-Cordovés (1985) for hue and by Heredia Mira and Guzmán Chozas (1990) for colouring intensity and luminance. However, other authors (Carrubba et al., 1985; Navarro et al., 1988) obtain significantly different levels for the monastrell and tempranillo varieties, probably due to the fact that colouring depends largely on grape variety.

In order to confirm that there were indeed two groups of samples, young and aged wines, the statistical significance of the results obtained was analysed. Table 2 shows that the difference was 99 % significant (\(\alpha < 0.01\)) for colouring intensity; 98% (\(\alpha < 0.02\)) for \(x\)-chromaticity.

![Figure 1. Section of the CIE (International Clarification Commission) chromatic diagram showing the approximate areas corresponding to each specific colour area (according to Lozano, 1979); • young, ■ aged.](image)

### Table 2

Descriptive statistics of the results obtained for chromaticity, colour intensity, hue and luminance, distributed according to young and aged wines, as well as statistics for total results. * \(\alpha\) values of significance tests of the differences between groups when colour parameter means are compared.

<table>
<thead>
<tr>
<th></th>
<th>Young wine</th>
<th>Aged wine</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>(N)</td>
<td>40</td>
<td>35</td>
<td>75</td>
</tr>
<tr>
<td>(x)-chromaticity</td>
<td>0.596</td>
<td>0.561</td>
<td>0.580</td>
</tr>
<tr>
<td>(y)-chromaticity</td>
<td>0.318</td>
<td>0.323</td>
<td>0.321</td>
</tr>
<tr>
<td>Colour intensity</td>
<td>4.48</td>
<td>3.46</td>
<td>4.01</td>
</tr>
<tr>
<td>(Hue)</td>
<td>0.873</td>
<td>0.938</td>
<td>0.904</td>
</tr>
<tr>
<td>Luminance</td>
<td>8.08</td>
<td>11.5</td>
<td>9.67</td>
</tr>
<tr>
<td>Relative luminance</td>
<td>0.541</td>
<td>1.94</td>
<td>0.541</td>
</tr>
<tr>
<td></td>
<td>23.9</td>
<td>31.3</td>
<td>23.9</td>
</tr>
<tr>
<td></td>
<td>23.9</td>
<td>31.3</td>
<td>23.9</td>
</tr>
</tbody>
</table>

Note: The table includes descriptive statistics for young and aged wines, as well as for the total samples. The \(\alpha\) values for significance tests of the differences between groups when colour parameter means are compared, are included.
value and 97% for hue and luminance. It was non-significant ($\alpha > 0.1$) for the $y$-chromaticity value.

A study was undertaken of the correlation in order to establish the linear relationship between certain physicochemical measurements, which influence in the colour of the wine. So multiple correlation of permanganate index, sulphur dioxide and pH with the colour was studied. In Table 3 can be seen that chromaticity ($x,y$) and colour intensity ($I$) are the parameters which achieve the best regression coefficient when colour is correlated with $IMn$ and $SO_2$. However, when the influence of pH is also studied, hue ($N$) is the colour parameter best defined by the three variables examined. The corresponding equation is as follows ($U = a + bX + cY + dZ$):

$$N = -0.6649 - 0.00858 \times IMn + 0.00064 \times [SO_2]^+ + 0.5029 \times pH$$

Figure 2 shows the graphic representation and Table 4 gives the confidence intervals and the significance levels for the respective coefficients of this linear regression.

Also, several non-linear mathematical models were assayed to establish relationship of the colour parameters with each other. The correlation coefficients are better than those for the linear combination are.

In conclusion, the permanganate index obtained is comparable to that of wines from other regions. With regard to colour, ageing for approximately 100 days leads to an increase in the average level of luminance and hue, whereas $x$-chromaticity and colour intensity both decrease. Hence, the marked evolution towards ageing clearly points to the need to consume this type of wines within the first year.

**REFERENCES**


EEC. 1990. Regulation 2676/90, 17 September, establishing the Community Analysis Methods to apply in the Wine


