

# Sensorial Impact of Sotolon as the “Perceived Age” of Tawny Port Wine

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## Introduction

The duration of the aging process in the production of Port has a fundamental role in determining the quality of the finished product. During long-term barrel aging, a number of specific compounds accumulate progressively. One such compound is Sotolon, (3-hydroxy-4,5-dimethyl-2(5H)-furanone) which imparts a typical aroma (1) which thus increases in intensity with age, usually described as “maderised” or “rançoso”. It is important to note that the barrel aged port wine quality category is attributed by the “Instituto do Vinho do Porto” (IVP) largely based on the sensorial properties. Hence the aim of this work was to: (i) evaluate the impact of Sotolon on the “perceived age” of Port wine; (ii) determining among some technological parameters; temperature; dissolved oxygen; pH and free SO<sub>2</sub> content; which has the greatest effect on the rate of Sotolon formation (iii) determine the kinetic of Sotolon formation as a function of time and temperature, for different regimes of dissolved oxygen.

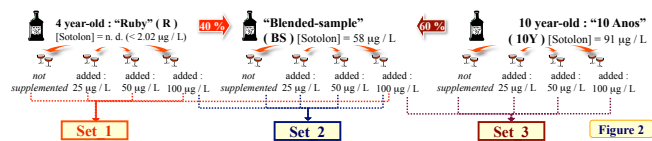
## Materials and Methods

**Wine material** - All wine samples were aged in “pipas” (550 L spent-oak barrels, and supplied by the Instituto do Vinho do Porto (IVP) after certification. **Wine Group 1** - Thirty-five samples of a single harvest ranging from 1 to 60 year-old “Colheitas”.

**Wine Group 2** - “Forced Ageing” experimental protocol: This protocol is similar that of a previous study (2). Wine treatments are described in figure 1. **Wine Group 3** - Kinetics Studies: 3 liters of 2-year-old Port wine was divided in 2 portions, one was saturated with oxygen, and the other was kept in absence of oxygen. Each portion was further divided and stored in sealed vessels at a temperature after 20, 30, 40, 50 and 60 °C during 77 days. Samples were analyzed at 0, 22, 30, 37 and 77 days. Kinetics of Sotolon formation were determined as a function of time and temperature.

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**Sensory studies**: Ranking tests were performed on wine samples of different ages with or without additions of Sotolon. Tests were performed in individual, booths, trained sensorial panel of 18 assessors, red light was used to mask visual differences between samples. Three samples were used, 4 year-old (R) and 10 year-old (10Y) and a Blended Sample (40% R with 60% 10Y). Samples were supplemented with three different levels of Sotolon, and three sets were constructed and presented to the panel as shown in figure 2.



The panelist were instructed to smell but not to taste and then order by age using a scale from 1 (youngest) to 5 (oldest) with unit intervals. The ranks were converted to scores according to Fisher and Yates (3) and subjected to ANOVA. Tukey's test was used to determine differences among samples. Mean Rating Scores (MRS) were arranged according to magnitude, and the HSD at 95% was determined. If for two samples MSRI-MSR  $\geq$  HSD they were regarded as significantly different (3).

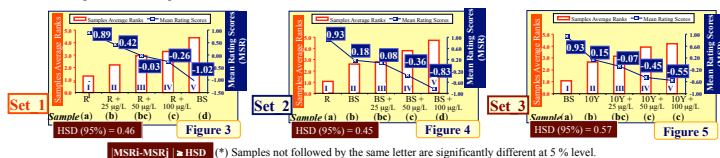
**Volatiles** were analysed by GC-MS (1) free SO<sub>2</sub> concentration by titration (4) and dissolved oxygen was measured using a “WTW 340 Oxygen Probe”. **Kinetics measures** - Statistical analysis was performed using the Statistica program version 6.0 (5). Both two-step and one step non-linear regressions (6, 7, 8) were performed, and a regression analysis of the residuals was also carried out.

## References

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## Results

**Sensory Studies**: ANOVA (95%) showed, for each set no differences between assessors and differences among samples. Results of the ranking test are shown figures, 3, 4, and 5.

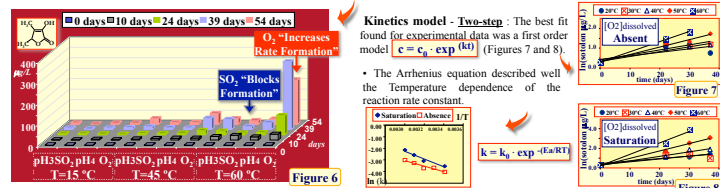


• Samples for the 3 sets were ranked by the panel on an increasing manner according to the real age and the increasing levels of Sotolon additions (Samples Average Rank).

• For Set 1 and Set 2, samples I, II, and V are significantly different from each other. The lower level of Sotolon addition on Set 1, was considered different from the sample not supplemented (I / II). This was not verified on Set 2 (II / III), due to the Sotolon concentrations present being close to the odor threshold 19 µg/L (1).

• Within Set 3 the differences are not so marked, nevertheless samples supplemented with 50 µg/L and 100 µg/L differed from the non-supplemented samples.

**Kinetics Studies**: Among the 4 parameters studied on the “forced aging” protocol, Temperature and dissolved Oxygen were the most important in influencing the rate of Sotolon formation (Figure 6).



• **One Step**: The Ea and k estimated at the reference temperature of 40 °C and the corresponding 95% confidence intervals, using the one-step nonlinear regression method, with and without the presence of O<sub>2</sub> are reported Table 1.

## Conclusions

- Sotolon concentrations correlates positively with time of aging of Tawny Port. Within certain limits Sotolon can also correlates with the intensity of typical aroma and “perceived age”.
- This phenomenon can be demonstrated even with Sotolon additions to a unaged base port.
- Oxygen was the most important parameter influencing the rate of Sotolon formation. Therefore, oxygen regimes during aging have a major impact on “age perception” this style of Port wines.

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model	Ea (kJ/mol)	k <sub>ref</sub> (days <sup>-1</sup> )	C <sub>0</sub> (µg/L)
[O <sub>2</sub> ] dissolved = Saturation first	87.1±11.0	0.011±0.003	3.69±2.0
[O <sub>2</sub> ] dissolved = Absence first	25.4±9.8	0.024±0.008	1.65±0.40