Definition of the Sensory and Aesthetic Spaces of Dry White Wines with Aging Ability by Experienced Tasters

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Article

Definition of the Sensory and Aesthetic Spaces of Dry White Wines with Aging Ability by Experienced Tasters

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Abstract: The popular appreciation of dry white wines is most frequently directed to young wines. However, present consumption trends comprise the valorisation of aged dry white wines. Therefore, the present work was aimed at the sensory analysis of these wines with different ages to define their sensory space and to understand which factors drive their quality evaluation by experienced tasters (critics, oenologists and students). Individuals were asked to evaluate several synthetic and aesthetic attributes and to characterise the analytic sensory profile through a Check-All-That-Apply (CATA) methodology. The quality evaluations were differently correlated with wine synthetic parameters according to the taster group. For both critics and oenologists, overall quality scores were driven by persistence and complexity. Moreover, quality was also highly correlated with power for critics and with balance for oenologists. Quality scores were highly correlated with wine browning (absorbance at 420 nm) for critics. The tasting panel showed a homogeneous analytic description of aroma, taste and mouthfeel consistent with wine age. The different ages could be associated to a continuous sensory space characterised by a decreasing perception of freshness and increase in mature and mellowed descriptors. All wines shared an austere in-mouth perception elicited by their acidity, saltiness, bitterness, smoothness and dryness. The age prediction showed that most tasters failed to guess the age wines with more than roughly 13 years old, indicating that tasters were not familiar with the sensory features of white wines with 17 to 46 years old. In conclusion, experienced tasters consistently described the sensory space and recognised the high quality of aged dry white wines. Education programs may use the defined sensory spaces according to aging and to expand the range of quality perception by consumers.

Keywords: white wines; fine wines; aging potential; appreciation; age prediction; browning; complexity; quality

1. Introduction

In wines, the meaning of ageing is concerned with the changes in chemical and aromatic composition that affect their sensory characteristics [1]. The most favourable type of aging in dry white wines is characterised by the loss of fresh fruitiness, and the development of aromatic nuances of honey, beeswax, straw, hay or nuts [2–5]. The yellow colour of an old white wine tends to vary from straw to amber [3,6]. The deviation from the favourable evolution is illustrated by the so-called atypical aging. In this process, the character of old wines is present in young wines leading to flavours of mothball, soap, rotten eggs, garlic or cooked vegetables, walnut/curry and bruised apple [5,7]. The distinction from wines with proper aging ability is not clear-cut since these aroma descriptors may also be found in developed top quality wines [8]. Thus, the thin line between proper and atypical aging justifies the examination of the respective distinctive sensory profiles.

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The concept of sensory space, defined as the characteristic sensory features of a product shared by a group of individuals [9], appears to be appropriate to characterise wines difficult to distinguish. The approach has been applied to the concepts of varietal wines [10–14], regional characterisation [15] or "green" wines [16]. Concerning aging, most research has been applied to red wines aging bouquet [17,18]. Thus, the scarcity of research on aged white wines and the present market interest for these styles, justify an adequate definition of their sensory properties, including those with an aesthetic significance, characteristic of fine wines [19].

The approach to develop sensory conceptual spaces in wines includes three steps: 1) identification of the sensory concept; 2) perceptual evaluation of the sensory space; and 3) sensory space description [20]. The first step has been performed using a mental descriptive questionnaire [21]. In sequence, this work was aimed to assess and define the sensory space of aged white wines, including the so-called aesthetic attributes characteristic of fine wines.

2. Materials and Methods

2.1. Wine Samples

Eighteen commercial white wines with different ages and two commercial red and rosé wines, used as distractors, from different Portuguese regions were used in this study (Table 1). The white wines had between one and 47 years old, and the distractors had 47 (red) and 15 (rosé) years old. The producers kindly supplied the wine samples. Before sensory analysis, three experienced tasters of the laboratory staff tasted the wines to check occasional flaws.

Table 1. Origin and absorbance (420 nm) of the tasted wines.

Code	Brand	Company	Region (sub-region)	Year	Absorbance
WDa74	Branco Dão	CEV[a] Nelas	Dão	1974	0.201
WBa91	Vinhas Velhas	Luís Pato	Bairrada	1991	0.782
WPe00	Catarina	Bacalhôa	Península de Setúbal	2000	0.484
WDa03	Casa de Santar	Sociedade Agrícola de Santar	Dão	2003	0.286
WBe03	Quinta dos Termos	Quinta dos Termos	Beira Interior	2003	0.284
WPe08	Pasmados	José Maria da Fonseca	Península de Setúbal	2008	0.695
WAl10	Cartuxa	Fundação Eugénio de Almeida	Alentejo	2010	0.221
WAl11	Dom Rafael	Herdade do Mouchão	Alentejo	2011	0.266
WBe11	Quinta Vale do Ruivo	José Madeira Afonso	Beira Interior	2011	0.111
WMe11	Alvarinho	Quinta do Soalheiro	Verde (Melgaço).	2011	0.379
WDa12	Pedra Cancela	Lusovini	Dão	2012	0.172
WMo12	Alvarinho	Palácio da Brejoeira	Verde (Monção)	2012	0.181
WMe12	Alvarinho	Quinta do Soalheiro	Verde (Melgaço)	2012	0.322
WDo13	Mau Feitio	Vinilourenço	Douro	2013	0.197
WAl15	Sericaia	Ares Alentejanos	Alentejo	2015	0.143
WMo16	Alvarinho	Palácio da Brejoeira	Verde (Monção)	2016	0.151
WLi18	Quinta do Monte d'Oiro	Quinta do Monte D'Oiro	Lisboa	2018	0.092
WDo20	Fraga da Galhofa (Moscatel Galego)	Vinilourenço	Douro	2020	0.091
Ro06	Fraga da Galhofa (Rosé)	Vinilourenço	Douro	2006	0.591
Re74	Periquita (Red)	José Maria da Fonseca	Península de Setúbal	1974	4.939

[a] State wine research center in Nelas, Dão region.

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2.2. Sensory Analysis

2.2.1. Tasting Panels

The study used three different experienced tasting panels. The first panel (critics) consisted of 9 wine critics and sommeliers (4 women and 5 men), aged between 26 and 72 years old (mean 52 years). The second panel (oenologists) consisted of 7 winemakers and oenology scholars (2 women and 5 men) aged between 28 and 61 years old (mean 49 years). These participants had more than 5 years of professional experience in wine tasting. The third panel (students) consisted of 14 oenology students (8 women and 6 men) from the second year of the Vitis Vinifera Master of Viticulture and Oenology Engineering (Instituto Superior de Agronomia, ISA), aged 22 to 40 years old (mean 27 years). Three sessions were held at the ISA Microbiology Laboratory. The participants were volunteers and informed that the tasting would be directed to assess aged white wines. Critics and oenologists tasted the wines on the 14th June 2021. The student session was carried out on the 9th July 2021.

2.2.2. Tasting Conditions

The tasting was divided into two parts, with 10 wines each. All samples were kept at a temperature of 19 ± 1ºC, and the tasting room had windows open for natural ventilation. The bottles were opened 30 minutes before pouring in transparent glasses (ISO 3591:1977) covered by glass Petri dishes. To limit carry-over effects and memory biases, samples were randomly distributed among tasters determined by a Williams Latin square design. The tasting sheet was divided into two parts (Supplementary Figure S1). The first part consisted of a score sheet for synthetic descriptors [22]. The second part corresponded to the taste/mouthfeel and aroma description using a Check-All-That-Apply (CATA) methodology. The attributes chosen for the CATA assessment were selected from a previous online survey [21]. Tasters could choose a maximum of 5 descriptors in in each taste/mouthfeel and aroma lists. After the CATA, respondents were asked to rate the quality and liking by drawing a line on a 9 cm unstructured scale anchored at both limits. The questionnaire ended with a question about the predicted age of the wine.

2.2.3. Data Analysis

The scores of the synthetic/aesthetic attributes were compared using one-way ANOVA by means of the Chi-square test ($\chi 2$) with α=0.05, since the score distribution was not normal. Therefore, the correlations among the attributes were obtained by using the non-parametric Kendall coefficient (tau-b). The analysis of the CATA was performed qualitatively since the data violated the test assumptions (i.e., no more than 20% of the expected counts were less than five and all the individual expected counts were one or greater). Furthermore, given the small sample size, both $\chi 2$ and alternatives tests had too low statistical power to detect statistically significant differences. Correspondence analysis (CA) was performed based on the contingency tables of the descriptors quoted more than 10% in, at least, one wine. Two cluster analysis were run, after data standardisation, using the Euclidean distance measure and the Ward.D clustering method, to obtain descriptor clusters (descriptors as rows and wines as columns) or wine clusters (wines as rows and descriptors as columns). Multiple Factorial Analysis (MFA) included the results of quality, colour (Abs 420 nm), age prediction and analytic descriptors. All analyses were performed using the using free statistical software Jamovi (version 1.8, www.jamovi.org).

3. Results and Discussion

3.1. Wine Synthetic and Aesthetic Scores

The comparison of the median scores given by all tasters to the synthetic and aesthetic attributes did not show differences among the wines (Table 2), reflecting the high individual variability in their assessment. In particular, the quality evaluation of the 20 tasted wines is shown in Figure 1,

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illustrating the unevenness of the scores. In certain wines, the scores varied more than 8 in a maximum scale of 10.

Table 2. Chi-square (χ^2) values of the scores given to synthetic and aesthetic attributes by the tasting panels to all wines (df, degrees of freedom, significant p-values < 0.05).

Attributes	χ^2	df	p
Familiarity	11.9	20	0.921
Number of Flavours	15.4	20	0.751
Ease of Identification	10.6	20	0.956
Harmonious	19.8	20	0.471
Balance	26.4	20	0.152
Linger	22.1	20	0.333
Strong/powerful	24.1	20	0.238
Complexity	27.0	20	0.134
Liking	29.6	20	0.076
Quality	26.1	20	0.161

The younger white wines (WLi18 and WDo20) tended to be scored with lower values. The rosé and red distractor wines also tended to have lower classifications (Figure 1). This behaviour indicated that tasters penalized wines that were not consistent with aged white wines by previously being aware of the purpose of the tasting. Interestingly, wine WBe11 (2011 vintage) was also in the lower range of values, probably because its sensory features were consistent with a younger wine.

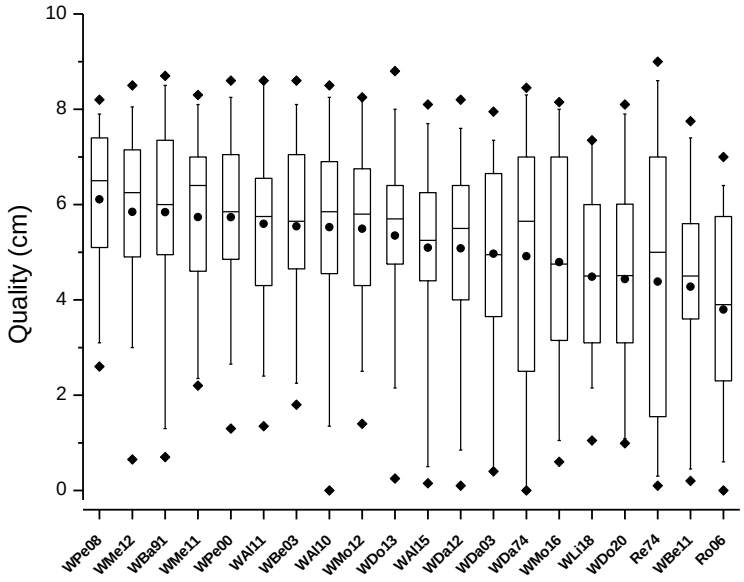

Figure 1. Distribution of quality scores given by critics, oenologists and students (Box plots: •, average; horizontal line, median; lower horizontal dash, 10% of the scores, higher horizontal dash, 90% of the scores; box, 25% and 50% of the scores, ♦, extreme scores).

The variability in quality scores by experienced or expert tasters has been documented [23], demonstrating that subjects have a strong idiosyncratic appraisal of aesthetic judgements. Indeed, the comparison between the panels (Figure 2) showed a different quality assessment. Ballester at al. [23] speculated that high correlations among quality judgements may be found among individuals with the same academic background (e.g. winemakers). In the present work, the different background of critics or the different years of experience (oenologists and students) might explain the differences in quality evaluation, together with a different utilization of the scoring scale.

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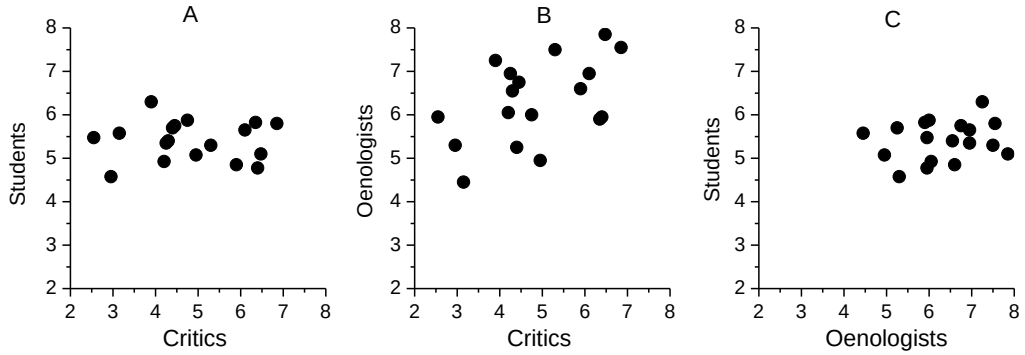

Figure 2. Correlation between median quality scores of dry white wines among the three panels (A, tau-b = 0.033, p = 0.881; B, tau-b = 0.255, p = 0.152; C, tau-b = 0.098, p = 0.601).

3.1.1. Effect of Experience on Quality Prediction

To understand more deeply, which factors might underlie the different quality evaluations of all tasted wines, correlations among the synthetic/aesthetic parameters were computed. The scores of all synthetic and aesthetic attributes are listed in Supplementary Table S1. When the responses of all tasters were merged, quality was highly correlated with persistence (linger) and complexity (Table 3). However, each tasting cohort contributed differently to this correlation. Indeed, critics associated quality with linger, power and complexity. Oenologists mostly associated quality with the number of flavours, balance, linger and complexity. The correlations obtained with students were all less strong than those of the more experienced cohorts were. Nevertheless, students showed higher correlations with balance and complexity. Overall, these results show that the evaluation of aged white wines is consistent with the definition of fine wines characterized by the valorization of aesthetic attributes such as complexity, persistence or balance [19]. The higher correlations obtained with balance than with harmonious probably reflect a semantic preference for balance that may be related with the concept of elegance [24].

Interestingly, quality was highly correlated with liking for critics and oenologists. These results demonstrate that, with experienced tasters, quality and liking are intrinsically related [25] being difficult to define if individual preferences are elicited by the aesthetic quality or if preferred wines must share higher aesthetic attributes, as hypothetised by Malfeito-Ferreira [26].

Table 3. Correlation (r) between the median quality scores and the rest of the synthetic descriptors and liking. Bold numbers indicate strong correlations using Kendall's tau-b (> 0.600).

Tasting Panels	Familiarity	Number of Flavours	Ease of Identification	Harmonious	Balance	Linger	Strong and Powerful	Complexity	Liking
Overall	0.193[1]	0.424[3]	0.150	0.467[3]	0.580[3]	**0.631[3]**	0.575[3]	**0.662[3]**	**0.770[3]**
Critics	0.211	0.474[2]	0.206	0.358[1]	0.505[2]	**0.691[3]**	**0.600[3]**	**0.758[3]**	**0.874[3]**
Oenologists	0.063	**0.600[3]**	0.263	0.589[3]	**0.705[3]**	**0.674[3]**	0.484[2]	**0.726[3]**	**0.842[3]**
Students	0.026	0.201	-0.058	0.406[2]	0.480[2]	0.185	0.180	0.522[2]	0.522[2]

[1] $p < 0.05$, [2] $p < 0.01$, [3] $p < 0.001$.

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3.1.2. The Influence of Colour on the Quality of White Wines

Colour is a factor that can influence the quality perception when wines are tasted in transparent glasses. As widely recognized [27–29], experienced subjects rely on top-down mechanisms [30] to assess wine quality and colour is the first sensory feature to drive their responses. In particular, older white wines, with brownish colour, tend to be regarded as over-developed [31]. In this work, tasters were not asked to rate the colour since the absorbance at 420 nm provided an objective measure of browning. The positive correlations between quality and colour (Abs 420 nm) only for white wines are depicted in Figure 3.

The tasters were aware that were experiencing aged dry white wines. Therefore, some degree of browning would be expected to influence the results. Indeed, light yellow wines were considered young and tended to be less rated. Quality median scores lower than 3.5 were only given by critics to the less brownish wines (WMo16, WLi18, WDo20, see Table 1). Similarly, the highest browning values were not scored lower than 6 in quality by critics (WBa91, WPe00, WPe08). The lower correlation was obtained with students, indicating that they were not so influenced by colour as critics and oenologists, probably explained by their higher experience [32].

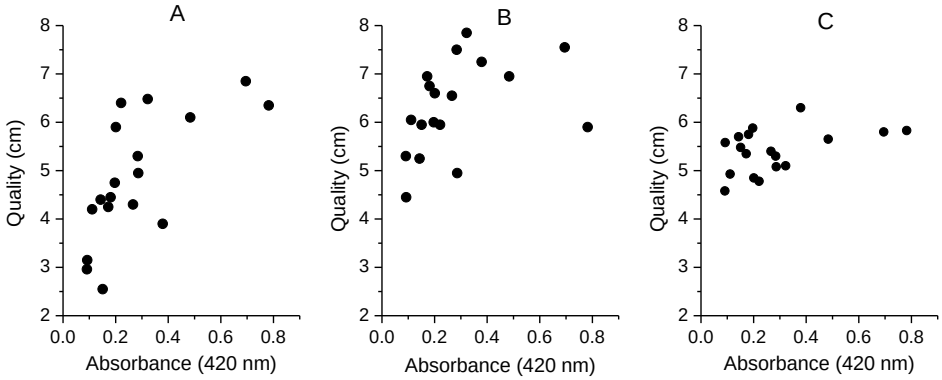

Figure 3. Correlation between median quality scores and absorbance of dry white wines among the three panels (A, critics, tau-b =0 .686, $p < 0.001$; B, oenologists, tau-b = 0.438, $p = 0.011$; C, students, tau-b = 0.315, $p = 0.069$).

3.2. Definition of the Sensory Space of Aged Dry White Wines

3.2.1. Analytic Descriptions

The wines were subjected to sensory analysis using CATA to obtain an analytical description of aroma, taste and mouthfeel properties. The results of the 3 tasting cohorts were pooled and the results are presented in two contingency tables (Supplementary Tables S2 and S3). The tasters checked all the available aroma (17) and taste/mouthfeel (12) attributes at least once. Interestingly, tasters did not report any additional descriptor related with occasional over-development that would be expected since old wines were being tasted. A total of 11 aromas were used for the sequent Correspondence Analysis (CA), where 10 were cited at least 10% in one of the white wines and bruised apple was also included because of its relation with possible oxidation. Therefore, straw, caramel, wet/flint stone and curry were present in white wines but were not included, while spicy and earthy were not used since were characteristic of red and rosé wines. Regarding taste and mouthfeel descriptors, astringency, sourness and roughness were not used since shared low frequency of citation for all wines (<10%).

The CA, based on the contingency tables only for white wines, was run using the retained aroma, taste and mouthfeel descriptors (Figure 3). The Chi-square value of the CA was 675 with a high significance in the discrimination ($df = 323$, $p < 0.001$). The taste and mouthfeel descriptors were not run separately because the p-value was > 0.05 (results not shown), indicating that wine discrimination is mostly due to aroma descriptors. Indeed, CATA might not be practical regarding taste and

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mouthfeel properties [33]. The first two CA dimensions explained 76.79% of the variance which shows an adequate discriminant power elicited by aroma descriptors. The in-mouth perception more distant from the center of the plot was sweetness that may be explained by the effect of fruity and flowery aromas on the so-called phantom sweetness in dry wines [34].

The localization of the quality scores of the 3 panels as illustrative variables in the central zone of the plot indicates that quality evaluation did not contribute to the sensory analytic discrimination of the samples.

The proximity in the space cannot be interpreted as direct association between wines [35]. For instance, the closer position of Mo16 than Da12 to chamomile does not mean that it smells more to chamomile. Consequently, the map is not sufficient to conclude on the differences between products. The basic correct interpretation is that the farther out a wine lies on an axis, the more frequently that attribute is associated with that wine [35]. Thus, the CA biplot shows a clear distinction of the younger wines (Do20 and Li18), in the left part of the quadrant, from the older wines in the opposed quadrant (Da74, Pe08, Ba91, Pe00, Da03). The attributes placed closer to the center mean that are not exclusive of any wine (Length, Saltiness, Bitterness, Acidity). The overall sensory projections show that the samples covered adequately the sensory space correspondent to dry white wines with different ages.

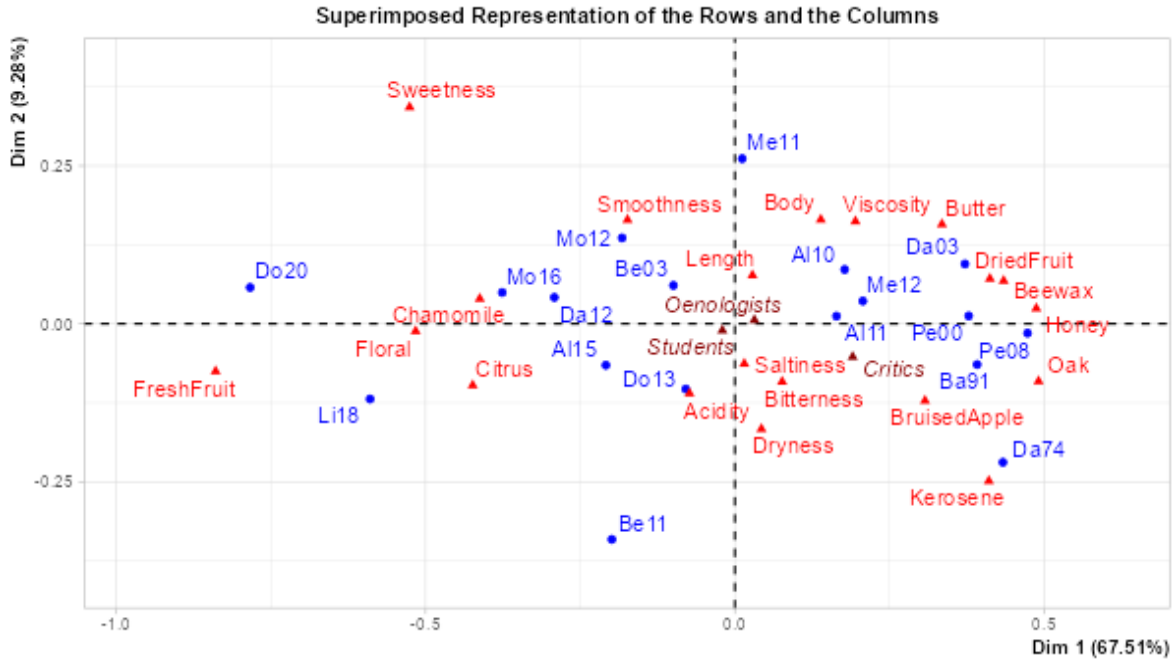

Figure 3. Correspondence Analysis of aroma, taste and mouthfeel descriptors of dry white wines. The median quality scores given by critics, oenologists and students were added as illustrative variables.

To understand the associations between the sensory descriptors, a cluster analysis was run and is depicted in Figure 4. The obtained clusters may be described consistently using a metaphor according to each dominant perception. Indeed, Freshness may be used to encompass the descriptors sweetness, fresh fruit, floral, citrus and chamomile, typical of young wines. Another cluster, coined as Mature, included the aromas of honey and dried fruit linked to body, length and viscosity. A third cluster included only aroma attributes (kerosene, bruised apple, butter, oak, beeswax), gathered under the overall perception of Mellowed wines [21]. The sensations of acidity and other in-mouth perceptions (saltiness, bitterness, smoothness and dryness) may be described under the umbrella of Austere, mostly used in popular wine press (e.g. www.wineenthusiast.com/basics/drinks-terms-defined/austere-wine-meaning, assessed on 5th May 2024). The frequency of citation of the descriptors in each sensory cluster is given in Table 4.

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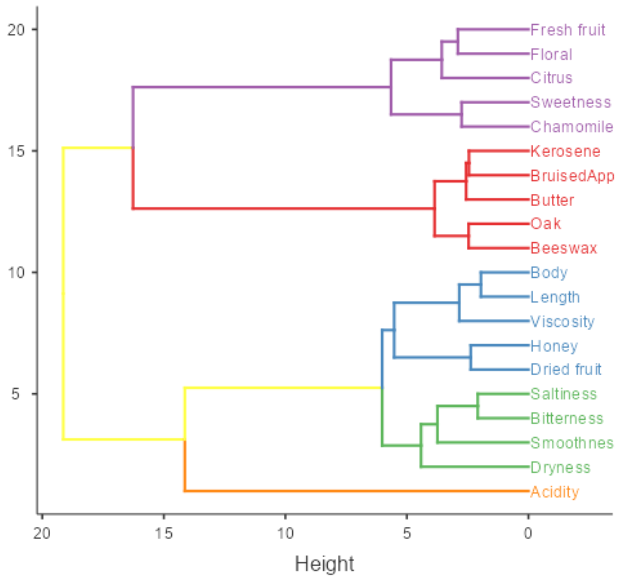

Figure 4. Cluster dendogram of sensory descriptors elicited by dry white wines with different ages.

Table 4. Frequency of citation of the perceptual overall clusters.

Clusters	Descriptors	Predicted age (years)			
		< 2	2-4	5-8	9-16
Freshness	FreshFruit	23	15	9	1
	Floral	22	12	12	5
	Citrus	18	18	12	7
	Sweetness	12	7	8	3
	Chamomile	13	8	8	4
	Total	88	60	50	20
Mature	Kerosene	1	5	5	8
	Bruised apple	3	5	5	10
	Butter	3	3	5	8
	Oak	1	4	7	11
	Beeswax	2	5	8	12
	Total	10	22	28	49
Mellowed	Body	7	7	15	14
	Length	9	11	14	13
	Viscosity	4	9	12	12
	Honey	2	6	11	17
	DriedFruit	2	7	11	16
	Total	24	40	62	72
Austere	Saltiness	10	11	12	11
	Bitterness	9	10	10	12
	Smoothness	15	10	12	9
	Dryness	14	15	13	16
	Acidity	27	26	23	23
	Total	75	71	71	72

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3.2.2. Predicted Age

The previous cluster analysis may also be applied to wines, according to their sensory description (Figure 5). The obtained 4 clusters correspond to different wines ages as perceived by the tasters. The results show that in 11 wines, the prediction differed by less than 3 years, comprising wines with real ages up to 12.5 years (Table 5). The difference in the prediction was higher for the older wines, being remarkable the case of WDa74, where the difference was roughly 36 years.

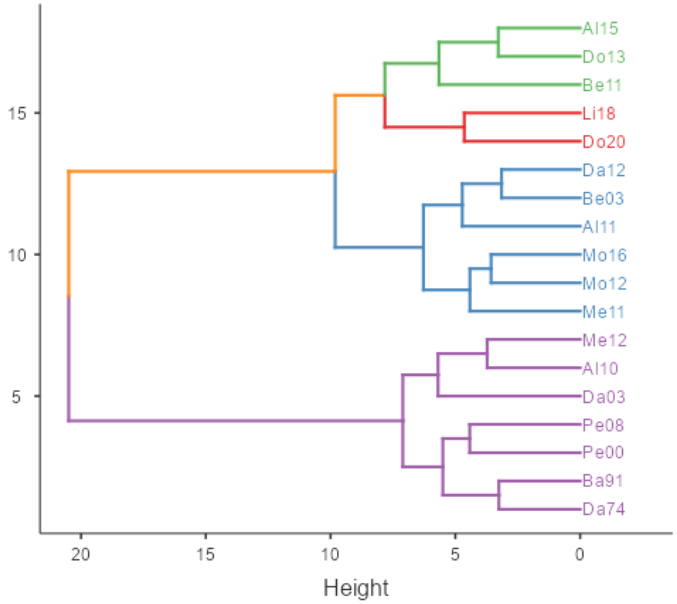

Figure 5. Cluster dendogram grouping dry white wines with different ages according to their sensory description.

Table 5. Average age prediction of the white wines reported by the tasting cohorts.

Cluster[a]	Wine	Real age	Predicted age	Difference
Very young	WDo20	0.5	1.4	-0.9
	WLi18	2.5	2.1	0.4
Young	WDo13	7.5	6.5	1.0
	WAl15	5.5	3.4	2.1
	WBe11	9.5	3.7	5.8
Mature	WMe12	8.5	9.5	-1.0
	WMo16	4.5	3.8	0.7
	WAl11	9.5	8.3	1.2
	WMe11	9.5	7.2	2.3
	WDa12	8.5	5.0	3.5
	WBe03	17.5	7.0	10.5
Mellowed	WAl10	10.5	10.7	-0.2
	WPe08	12.5	13.8	-1.3
	WMo12	8.5	7.3	1.2
	WPe00	20.5	13.6	6.9
	WDa03	18.5	10.9	7.6
	WBa91	29.5	16.3	13.2
	WDa74	46.5	10.9	35.6

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The prediction may be explained by the sensory conceptual space of the wines. Indeed, when wines were grouped according to their predicted age and to the frequency of citation of the clusters depicted in Figure 4, the output may be regarded as the sensory evolution of dry white wines during aging (Figure 6). As expected, this evolution was characterized by a decrease in the Freshness perception. Yet, some fresh fruitiness may be kept [8], accompanied by an increase in the evolved wine attributes, comprising Mature and Mellowed perceptual spaces. Interestingly, the Austere perception underlies all ages with a slight reduction with time. This behavior is consistent with the metaphor "mellowed by aging" proposed during the initial conceptual definition [21].

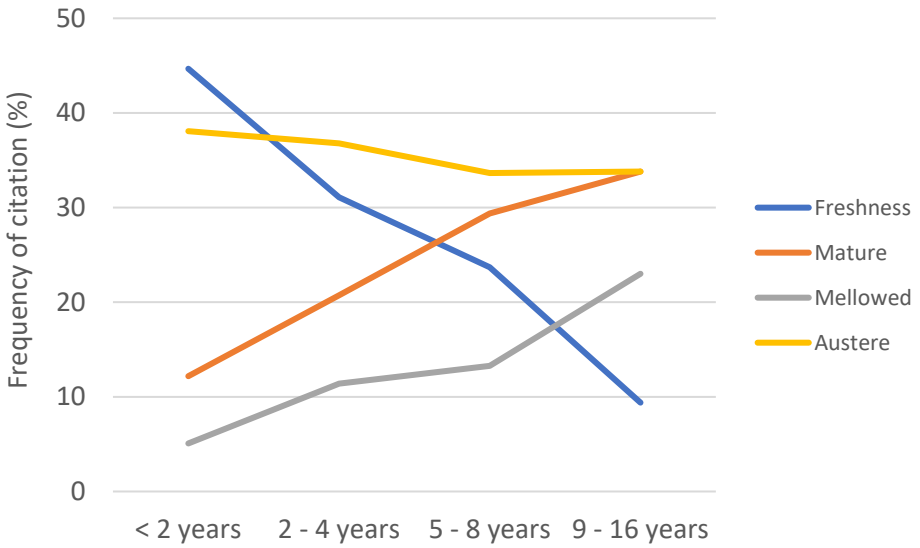

Figure 6. Sensory characterisation of dry white wines grouped according to their predicted age.

3.3. Overall Factors Affecting Quality Evaluation

The evaluation of the different factors that influence quality was performed by Multiple Factorial Analysis (MFA), using absorbance (420 nm), sensory descriptors and predicted age as variables. The first two components explained 68.7% of the variance (Supplementary Table S4). The variables contributing to the PCA are shown in Figure 7. The axes oppose the perception of Freshness (left position) to the perception of Mature (beeswax, oak) and Mellowed (dried fruit, honey, viscosity) wines. In the middle of the plan appears acidity, indicating that this attribute does not distinguishes younger from older wines. Even though, the onset of browning is regarded as a negative event [36], Figure 7 also shows that quality could be related to an acceptable degree of browning (Abs 420 nm). Therefore, the dry white wines most valorized by the tasters shared sensory attributes typical of older wines, within a predicted age range.

Figure 8 shows the discrimination of the dry white wines based on a priori grouping according to age perception. Wines were clearly separated, with younger samples in the lower left quadrant, mellowed wines in the lower right quadrant, while mature wines were placed in the higher quadrants.

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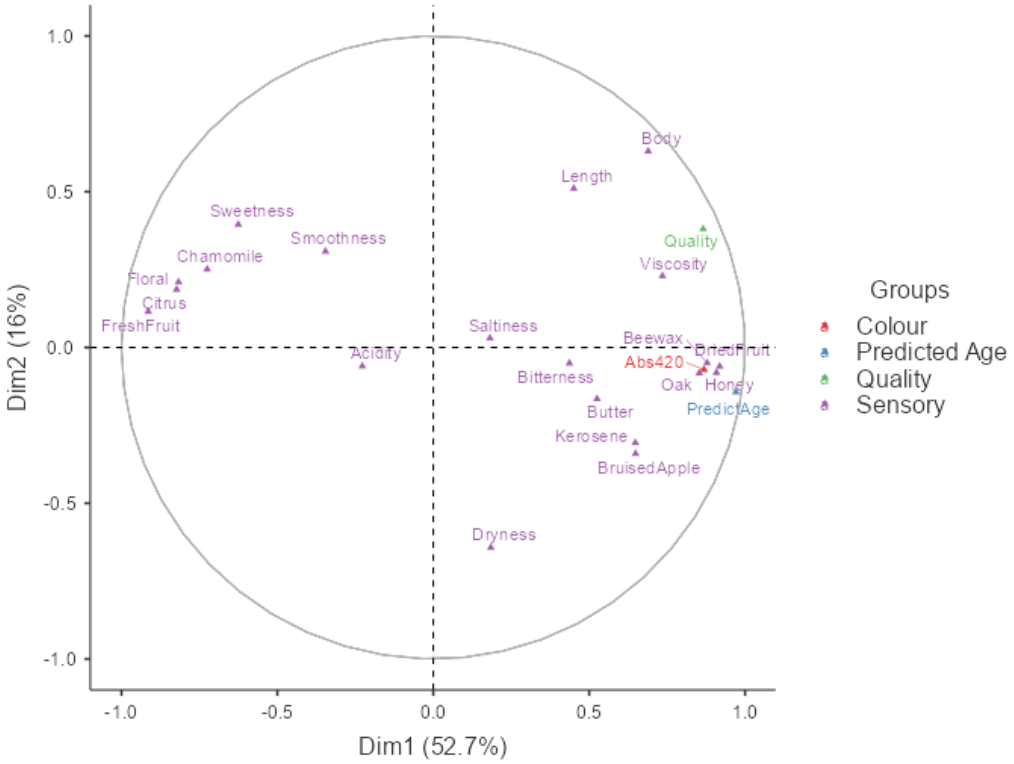

Figure 7. Multiple Factorial Analysis of dry white wines displaying the quantitative variables related to Colour (Abs 420 nm), Predicted Age, Sensory attributes and Quality.

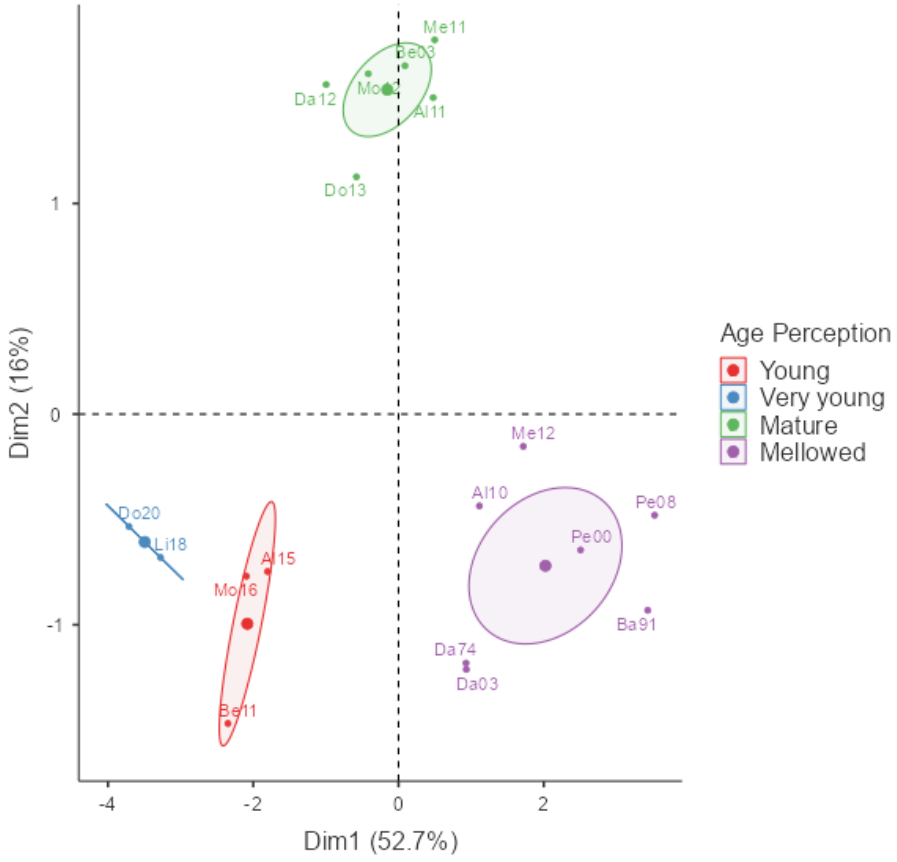

Figure 8. Multiple Factorial Analysis of dry white wines grouped according to the age perception.

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3.4. Limitations of the Study

The fact that each cohort had a small number of tasters limited the significance of results regarding the effect of experience on the evaluation of synthetic factors affecting the aesthetic properties of the wines. In addition, a large variability of responses regarding synthetic/aesthetic attributes could probably be reduced by extensive training to calibrate the responses and by outlier deletion. However, no attempt was made to remove outliers since Parr [37] stated that this variability is intrinsic to sensory analysis and "not and error in the machine". Nevertheless, the sensory analysis using CATA provided information that elicited a consistent definition of the aging sensory concept of dry white wines. The utilization of dark glasses would have reduced the top-down effects on sensory description but the intent was to check if brownish wines could be underscored, which did not occur. In addition, regarding the complex nature of wine ageing it would have been interesting to check the evolution of the sensory attributes with time after pouring wine in the glasses [38].

The experimental outputs obviously depend on the wines selected for the study. Even if the tasted samples covered the sensory range from younger to older wines, it would have been useful to have clearly substandard dark brown oxidized wines to establish the boundaries between not-faulty/faulty wines, which appear to be easier to define in whites rather than in red wines [39]. Another limitation concerns the use of other grape varieties, or wines from international regions known for their aging potential [40], to cover sensory features different from those of Portuguese wines.

4. Conclusions and Future Prospects

The results indicated that tasters with different degrees of expertise and experience properly valorized aged dry white wines. The variability in the assessment of properties with aesthetic value indicates that there is an idiosyncratic appreciation that underlie fine wine quality. In particular, critics and winemakers showed different quality inferences mainly regarding the contribution of power and balance. To these cohorts, liking was intrinsically related to quality evaluation. The influence of browning on quality evaluation was an indication of top-down processes that were more evident among the critics.

The utilization of CATA methodology enabled to evidence the attributes consistent with the sensory space of "wines mellowed by age". The boundaries between younger and older wines were dependent on the decreasing perception of freshness and with the concomitant increase in the perception of maturity and mellowed flavours. A constant perception of austerity spanned the sensory continuum, which may be envisaged as the structure on which builds the aging potential of dry white wines.

Overall, this study demonstrated the fine wine quality attributes of aged dry white wines and contributed to the definition of the sensory space of "wines mellowed by age". Wine education programs might use this defined sensory space together with the corresponding aesthetic attributes to expand the range of quality perception by consumers.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org, Figure S1: Tasting sheet used in the study; Table S1: Mean scores of colour (Abs 420 nm) and synthetic/aesthetic attributes given by the 3 tasting cohorts; Table S2: Contingency table of aroma analytical descriptors (those retained for Correspondence analysis are written in bold); Table S3: Contingency table of analytical taste and synthetic mouthfeel descriptors (those retained for Correspondence analysis are written in bold); Table S4: Eigenvalues and variance of the PCA elicited by the factors affecting quality evaluation.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author due to the absence of a data repository for this specific dataset.

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