

# The role of production process and information on quality expectations and perceptions of sparkling wines

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## Abstract

**BACKGROUND:** This study, by combining sensory and experimental economics techniques, aims to analyse to what extent the production process, and the information about it, may affect consumer preferences. Sparkling wines produced by Champenoise and Charmat methods were the object of the study. A quantitative descriptive sensory analysis with a trained panel and non-hypothetical auctions combined with hedonic ratings involving young wine consumers ( $N = 100$ ), under different information scenarios (*Blind*, *Info* and *Info Taste*), were performed.

**RESULTS:** The findings show that the production process impacts both the sensory profile of sparkling wines and consumer expectations. In particular, the hedonic ratings revealed that when tasting the products, both with no information on the production process (*Blind*) and with such information (*Info Taste*), the consumers preferred the Charmat wines. On the contrary, when detailed information on the production methods was given without tasting (*Info*), consumers liked the two Champenoise wines more.

**CONCLUSION:** It can be concluded that sensory and non-sensory attributes of sparkling wines affect consumers' preferences. Specifically, the study suggests that production process information strongly impacts liking expectations, while not affecting informed liking.

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**Keywords:** sensory; hedonic ratings; experimental auctions; information; willingness-to-pay (WTP); sparkling wine

## INTRODUCTION

The food quality perception process has been extensively analysed in the literature, and several theoretical approaches have been developed.<sup>1–3</sup> To summarize, the quality dimension can be defined as a product-specific evaluation that consumers assign based on the attributes of the product. Food attributes are generally divided into intrinsic (physical) and extrinsic product attributes.<sup>4</sup> Both intrinsic and extrinsic attributes may influence consumers' quality expectations and perceptions, and the resulting choice. While intrinsic attributes, such as sensory properties, are naturally associated with consumers' preferences,<sup>5–7</sup> several studies have demonstrated the impact of extrinsic food attributes on quality expectations and perceived hedonic valuation (for a complete review, see Piqueras-Fiszman and Spence<sup>8</sup>) as being important quality signals.<sup>3</sup> On the other hand, the same expectations play an important role in food-purchasing decisions as they can positively or negatively influence the quality perception of the product.<sup>9</sup> Expectations can originate from a wide variety of different extrinsic attributes, such as brand,<sup>10</sup> price,<sup>11</sup> health and nutritional values,<sup>3,12</sup> and information about production processes or origin.<sup>13,14</sup> Thus, the available information affecting expectations can have a relevant effect on consumer liking and acceptability of the product.<sup>15</sup> Providing information on the production process,

on the origin, or on the ingredients of a food product is a way in which marketing managers attempt to provide consumers with evidence of desirable product characteristics.<sup>16,17</sup>

In recent years, many consumers have become more concerned about non-sensory factors, influencing their liking and choice of foods.<sup>18</sup> Thus, an increasing number of firms are focusing their marketing efforts in communicating what food contains, where it comes from, and how it is produced.<sup>19–21</sup> As for the latter aspect, information on the processes employed in food production is increasingly communicated and the consumers are more actively involved in searching for information on this specific aspect.<sup>22–24</sup> This study aims to analyse how and to what extent the production process, and the information given about it, may affect consumer

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preferences in terms of quality expectations and perceptions. Indeed, studies that combine both sensory and extrinsic factors make it possible to obtain more complete and realistic information about consumer behaviour in everyday shopping.<sup>25,26</sup> Furthermore, several studies demonstrate that a core motivation of consumers' repeated purchases is the food's taste.<sup>27–29</sup> Therefore, it is essential to include taste when exploring the drivers of consumer preferences in experimental designs.<sup>30</sup> This type of information is especially important for marketers and researchers, to deeply understand the interplay of sensory and non-sensory attributes.<sup>31</sup> As few studies have investigated the relative importance of process information and taste of wine, this product was selected for the present study. Wine is a powerful exemplar as both intrinsic and extrinsic attributes affect consumers' quality perceptions and preferences.<sup>32,33</sup> Furthermore, wine is a product for which the sensory judgment, both analytic and hedonic, is strongly impacted by the extrinsic attributes.<sup>32,34–36</sup> Wine consumers tend to rely on extrinsic cues, such as price, packaging, and labelling, also to mitigate the risk of a bad purchase.<sup>37</sup> Moreover, previous studies show that an important trade-off exists in quality perception among different wine extrinsic cues, such as origin, denomination of origin, and label aesthetics.<sup>35,38</sup> While there are a large number of empirical studies investigating general consumer preferences for still wines, much less attention has been devoted to exploring the core drivers of valuation for sparkling wines.<sup>39–42</sup> The experienced quality of sparkling wines is influenced by several oenological variables, such as grape variety,<sup>43</sup> yeast selection, and ageing,<sup>44</sup> but among them the method of secondary fermentation plays an outstanding role.<sup>45,46</sup> The role of the method employed for the secondary fermentation (Champenoise or Charmat) in consumers' preference formation is crucial to analyse, since not only may it have a great impact on the intrinsic characteristics of the product, mainly the sensory profile, but it also has a large weight on the final price of the wine, with the Champenoise method being the more time and money consuming. Many studies on sparkling wines have focused on the extrinsic factors influencing consumers' purchasing preferences, such as country of origin, brand, and occasion,<sup>40,47,48</sup> whereas little empirical evidence is available on the effects of either sensory characteristics or external information, about market placement and reputation, on overall evaluation, and what there is limited to French Champagne.<sup>39,42</sup> A recent study investigated the influence of production method on the consumer acceptance of Australian sparkling white wines, while the role of information about the process was not considered.<sup>49</sup> In the present study, sensory and experimental economics techniques have been combined to provide a picture of the influence of sparkling wines' production method, including related information and sensory differences, on young consumers' preferences. The following research propositions were developed and were empirically assessed by testing four hypotheses: the production process impacts the sensory profile of sparkling wines (H1) and thus affects consumer liking (H2); information on sparkling wine production process influences consumer expectations (H3); and finally, consumer preferences for sparkling wines (measured in monetary terms) are influenced by both information on the production process and hedonic liking (H4). The assessment of hypotheses H2–H4 will shed light on the role of information in moderating consumers' preferences and on the differences between informed liking and expected liking. Therefore, these aspects will be specifically investigated. While a quantitative descriptive sensory analysis was performed for testing the first research proposition (H1), the other research

propositions (H2–H4) were tested using a sample of young wine consumers and hedonic evaluations with non-hypothetical experimental auctions under different information scenarios.

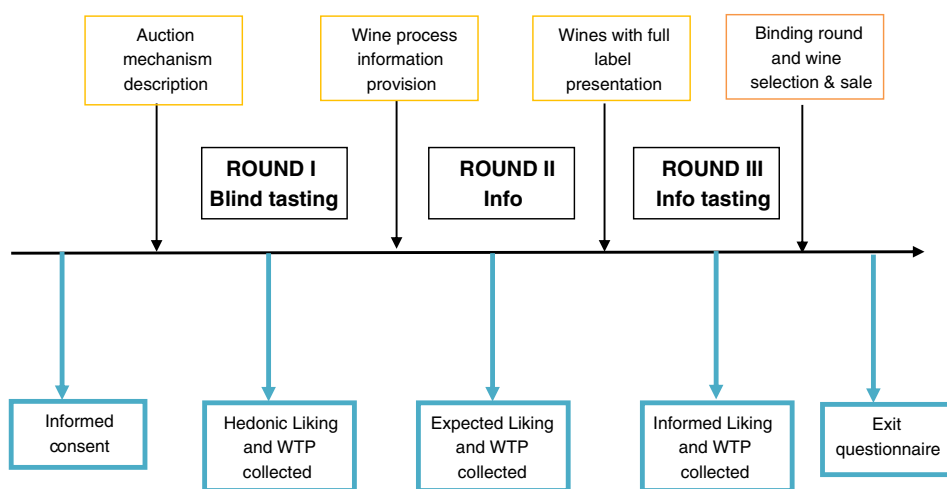
## MATERIALS AND METHODS

### Sparkling wine samples

Four different sparkling wines were considered for the study. Two of the wines were produced by the Champenoise or traditional method and the other two by the Charmat method. For each method of production, two grape varieties were transformed: a red variety (*Vitis vinifera* cv. Aglianico) and a white variety (*V. vinifera* cv. Falanghina), both native of southern Italy, and cultivated in an area surrounding Benevento province. All the wines were elaborated in an experimental winery, following the winemaking procedures detailed in Appendix A. To identify potential tangible differences in the odour and taste among the four sparkling wines, and thus for testing whether the production process impacts the sensory profile of sparkling wines (H1), a quantitative descriptive sensory analysis was carried out. The panel was composed of 10 judges (four males and six females, 26–48 years of age) recruited from the staff and the students of the Department of Agricultural Sciences of the University of Naples Federico II, selected on the basis of their sensory abilities, trained in performing sensory descriptive analysis of wine and with extensive experience in sensory descriptive analyses of various wine typologies (including sparkling wines). All the sensory tests were conducted in individual sensory booths. The samples (30 mL) were presented at a temperature of 8 °C in black tulip-shaped glasses, coded with random three-digit codes. Each sample was served from two different bottles of each wine (half volume from each bottle). Samples were evaluated in duplicate (two duplicate sessions), according to a randomized complete block design. Odour attributes (orthonasal evaluation) were determined by consensus after the panel had evaluated the experimental wine samples and had discussed to reduce the number of descriptors, in two dedicated sessions before the measure sessions. Seven odour descriptors (O) were generated: fruity, citrus (lemon and orange zest), floral, sweet odours (honey, vanilla, caramel), vegetative–herbaceous, spicy, yeast–bakery. With regard to the taste descriptors (T), sweet, sour and bitter were evaluated. Moreover, the judges could also quote and rate other oral attributes, if perceived (i.e. astringency). The intensities of the taste and odour descriptors were rated using a nine-point scale (0 = not detected, 1 = weak, 2 = medium, 3 = strong, 4 = very strong, half values being allowed).

### Consumer sample

One hundred young wine consumers living in the Campania region (southern Italy) participated in Spring 2016 for the hedonic evaluations and experimental auctions of the four sparkling wines in order to test the research hypotheses H2, H3 and H4. Recruitment was contracted to a consumer association which screened participants to be: (a) of legal drinking age (over 18) and up to 36 years old and (b) buy sparkling wines at least once every 3 months. Individuals who satisfied these conditions and agreed to participate received a written notification to attend a given session. This notification included a brief description of the general purpose of the experiment and a note that an auction would take place allowing them to buy some of the wines tasted. The research focused on young adults (18–36 years old), as these consumers constitute one of the most relevant target groups for the wine



**Figure 1.** Consumer experiment design and timeline.

world in the immediate future.<sup>50</sup> The sample size was set at 100 participants following other studies with a similar approach.<sup>51,52</sup>

**Experimental design**

This study is based upon a combination of hedonic evaluations with experimental auctions under different information scenarios following the approach proposed by Combris *et al.*<sup>53</sup> Experimental auctions have several important merits compared with other valuation tasks. Most importantly, they are incentive compatible; that is, a participant’s best strategy is to reveal the true value of the good, as underbidding and overbidding impose real economic costs.<sup>54</sup> In addition, experimental auctions allow researchers to sell real products, controlling for all the factors that might influence consumer valuations. Overall, experimental auctions are widely appreciated by scholars as they are an excellent method of determining relative willingness-to-pay (WTP) values for similar products.<sup>55</sup> Lusk also reveals that experiments with food products have a relative high level of external validity compared with experiments dealing with non-food products (or with topics such as real estate, charity, or contribution to public goods).<sup>56</sup> Many different auction techniques exist; we applied the Vickrey-style fifth-price auction,<sup>57</sup> with participants submitting sealed bids for all the auctioned products (full bidding), with the top four bidders winning the auction and paying the fifth highest bid for the binding good. This mechanism was selected as previous research has demonstrated that this auction provides the highest punishment from non-truthful bidding when one jointly considers low-, medium-, and high-value bidders.<sup>58</sup> Moreover, compared with the Vickrey (second price) auction, it engages more effectively all bidders – owing to more bidders having the possibility to purchase the product. Specifically, 10 sessions were organized in a university sensory laboratory (during Spring 2016), on 10 consecutive weekdays, with 10 participants in each. The experiment utilized a within-subjects design; that is, all participants performed exactly the same protocol (Fig. 1). Specifically, the four sparkling wines were first evaluated after blind tasting (*Round I – Blind*), in order to test whether the production process affects consumer hedonic liking (H2). Subsequently, the four sparkling wines were evaluated after examination of the labels and the provision of additional information on the two winemaking processes, and without tasting the samples (*Round II – Info*) for testing whether information on the sparkling wine production process influences

consumer expectations (H3). Finally, the four wines were evaluated after examination of the labels and tasting (*Round III – Info Taste*) for assessing whether consumer preferences for sparkling wines are influenced by both information on the production process and hedonic liking (informed liking) (H4). In *Round II – Info*, subjects were given handouts containing basic information on the Champenoise and Charmat production methods; the descriptions of both methods were as much as possible homogeneous, in terms of number of sentences and images and type of information (Appendix B shows the handout that participants received in the information round). Half of the participants had the description of the Charmat method on the left and the other half on the right side of the sheet, in order to balance the position effect.

Each session began with asking participants to sign a consent form. Subsequently, individuals were compensated for their opportunity cost of taking part in the experiment (€10),<sup>59,60</sup> followed by a careful explanation that this money should not be considered as windfall money. The time lapse between the endowment and the bidding is sufficiently long (due to training and explanation of the entire experiment) to separate effectively the act of paying from deciding an individual’s WTP. This procedure also avoids problems of cash constraints.<sup>61</sup> In an attempt to reduce potential social desirability bias, all the sessions were conducted by an experimenter that was not involved in the initial compensation of participants.

The experimenters strictly read the printed instructions in order to minimize session effects. A training auction (with hypothetical sale) with chocolate cookies was performed to check that all participants had properly understood the specific auction mechanism. Specifically, drawing on Lusk and Shogren,<sup>61</sup> we trained participants by: (i) carefully explaining the auction mechanism; (ii) providing concrete numerical examples; (iii) clearly explaining why each person should bid truthfully; (iv) using a simple quiz to test individuals’ knowledge of the explained mechanism; (v) allowing questions to improve understanding before the focal auctions; (vi) conducting practice rounds with chocolate cookies; and (vii) imposing anonymity. Researchers stressed that individuals were not requested to try to guess the price of the auctioned sparkling wines, but to express the maximum price point at which they were willing to purchase the products. It was also explained that if participants did not wish to buy a certain sparkling wine, zero bids would be fully appropriate. Reference prices were not given for

each of the products prior to bidding to avoid an anchoring effect, and bids were not posted.<sup>62,63</sup>

Participants were subsequently seated in separate, individual, tasting booths and strongly requested to avoid any form of communication (to prevent explicit collusion). A three-digit code was randomly assigned to the products to avoid expectation errors, both between and within rounds (brands were not visible on any bottle). Each wine (30 mL) was served in standard glasses (UNI ISO, 1979) at a temperature of  $6 \pm 2$  °C. The samples (wine samples in *Rounds I and III* and labelled bottles in *Round II*) were presented according to a randomized complete block design. The sale was conducted at the end of the third round of each session, using the fifth-price auction procedure described previously, with only one, randomly drawn, binding round and one binding wine (to avoid demand reduction effects). This information was carefully explained to participants before starting the experiment. The entire session lasted about 1.5 h, at the beginning of the afternoon (15:00). No deception was applied, as all information provided (at all stages) was perfectly correspondent with the actual wines auctioned.

### Wine tasting, knowledge, and involvement

Hedonic ratings, in terms of overall liking, were collected using a nine-point hedonic categorical scale with the following anchors: 'I find it extremely unpleasant' (=1), 'I find it very unpleasant' (=2), 'I find it unpleasant' (=3), 'I find it slightly unpleasant' (=4), 'It leaves me indifferent' (=5), 'I find it slightly pleasant' (=6), 'I find it pleasant' (=7), 'I find it very pleasant' (=8), and 'I find it extremely pleasant' (=9). Before concluding the experimental session, all participants answered questions regarding their socio-demographic situation, wine knowledge and involvement (see Appendix C for complete details), sparkling wine consumption, and buying habits. In particular, as previous literature has demonstrated the importance of consumer-related characteristics for understanding consumer behaviour,<sup>64</sup> a factual knowledge test with 10 questions was used to assess wine objective knowledge (see Appendix D). The 10 questions (adapted from Vigar-Ellis *et al.*<sup>65</sup>) probed respondents' knowledge of several aspects of wine, ranging from the production process to designations of origin. The final knowledge score was computed by counting the number of correct answers to the 10 questions (knowledge score ranging from 0 to 10).

### Data analysis

Mean intensity was calculated for each cited taste (T) and odour (O) descriptor. The production process impact on sensory profile of sparkling wines (H1) was analysed by performing a three-way analysis of variance (ANOVA), with panellists, variety and production process as factors and the panellist effect being considered as a random factor. When the production process effect was significant, the four experimental wines were compared by a Tukey test ( $P < 0.05$ ). Hypotheses tests on consumer samples (H2, H3 and H4) were conducted using a paired (within-treatment effect) Wilcoxon signed-rank test, with a statistical significance of  $P < 0.05$ , aiming to statistically identify the differences between the two production processes (Champenoise *versus* Charmat). Formulas employed refer to a conventional 'differences estimator',<sup>66</sup> where the difference of a set of measures (liking and WTP) for the Charmat and Champenoise is compared within the same sample by using paired Wilcoxon signed-rank test. The Wilcoxon signed-rank test is a non-parametric equivalent of the paired *t*-test; its use is suggested when normality of differences does not hold, with the null

hypothesis that the central point of the distribution of the differences is expected to be zero, or no difference between the two distributions under comparison can be observed.<sup>67</sup> (Indeed, collected WTP and hedonic ratings do not hold to the normality distribution assumption. The latter is not unexpected, since hedonic ratings were measured on a 1 to 9 scale, while WTP distributions are skewed.) The Wilcoxon signed-rank test was used also to test whether the order of presentations of the two production methods had an impact on the preferences (liking and WTP). Order had no impact.

## RESULTS

### Sensory profiles of the sparkling wines

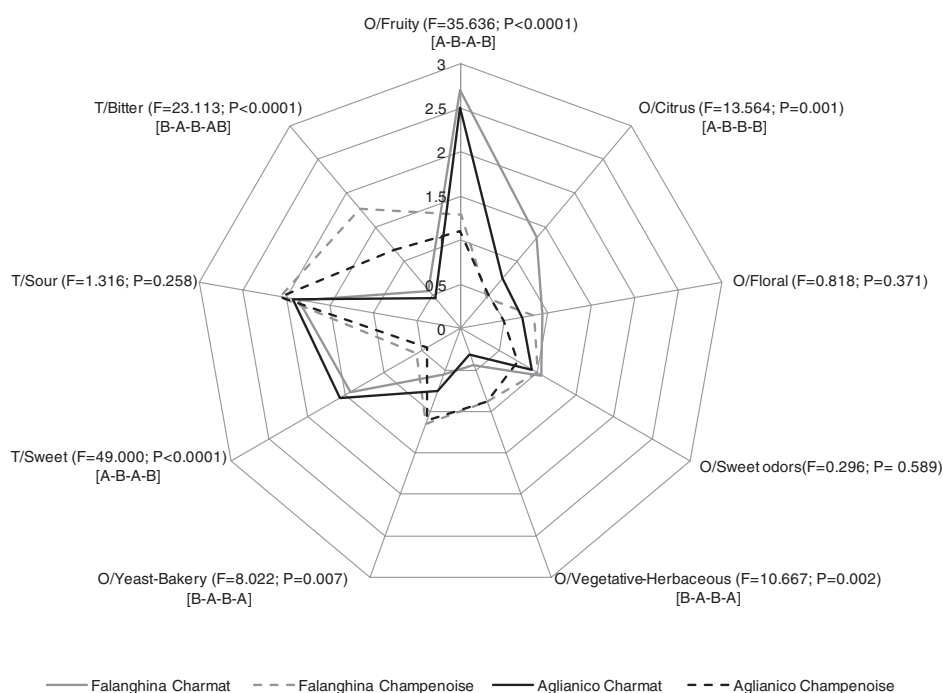
The sensory profiles of the four sparkling wines evaluated in this study are shown in Fig. 2. The results are expressed as mean intensity (MI). The two Charmat wines show similar profiles, mainly characterized by a strong fruity odour and sour and sweet tastes. Furthermore, the two Champenoise wines have common features: sour and a bit bitter, with odour profiles characterized by fruity, yeast and vegetative odours. The three-way ANOVA (panellists, variety and production process as factors) conducted on intensity data showed that the factor 'panellist' was significant only for the odour descriptor 'spicy' ( $F = 2.257$ ;  $P = 0.038$ ). 'Spicy' was therefore eliminated from the sensory profile, since judges were not consistent in its evaluation. The effect of the factor 'variety' was not significant for all the sensory descriptors, while the production method was significant for the odour descriptors 'fruity', 'citrus', 'vegetative-herbaceous', 'yeast-bakery' and for 'sweet' and 'bitter' tastes.

Considering the MI comparisons, the main discriminating descriptors among the two production methods are the terms 'fruity' and 'sweet', with a significantly higher MI in Charmat wines, followed by 'yeast-bakery', and 'vegetative-herbaceous' being higher in the two Champenoise wines. The 'bitter' taste has a higher mean score in the two Champenoise wines; however, it is significantly different only between Falanghina Champenoise and the two Charmat wines. The score obtained by Falanghina Charmat for the 'citrus' odour (described as lemon and orange zest) is significantly higher with respect to the other wines, although both the Charmat wines have a higher mean score than the Champenoise ones. For this descriptor, a significant interaction between the factors 'production method' and 'variety' ( $F = 4.333$ ;  $P = 0.044$ ) has been detected; this result could be explained by previous data suggesting that Falanghina wines are richer than Aglianico in terpenes, the volatile compounds usually involved in citrus odours.<sup>68,69</sup> 'Sour' taste and 'floral' and 'sweet odours' were not discriminants among the samples, regardless of the production method.

### Consumer sample characteristics

Regarding the socio-demographic characteristics of the participants, the overall sample had a mean age of 25.4 years (standard deviation (SD) 6.8 years), 36% of participants were female, household average size was 4.08 individuals (SD 0.96) and 61% stated to have an annual family income aligned with the national benchmark (€30 000). Participants' wine-related characteristics are reported in Table 1. Among the attributes most preferred when selecting wines, we should highlight that grape variety ranked first (mean 4.35), followed by origin (mean 4.21). Moreover, 49% of the sample affirmed to buy wine in specialized stores usually.





**Figure 2.** Flavour profiles of the experimental sparkling wines (mean intensity, MI). Note: T, taste descriptors; O, odour descriptors. *F* and *P* values in parentheses are relative to the production process effect (three-way ANOVA). Letters in brackets refer to the results of a multiple comparison by Tukey test ( $P < 0.05$ ) in the following order of samples: Falanghina Charmat–Falanghina Champenoise–Aglianico Charmat–Aglianico Champenoise.

### Hedonic ratings

All participants first gave hedonic ratings and then WTP for all wines in each round. Regarding the production process impact on consumer liking (H2), analysis of the hedonic rating scores on the four wines (Fig. 3) reveals that respondents prefer the Charmat-processed wines when the products are blind tasted (i.e. *Round I – Blind*), with all differences statistically significant, thus confirming H2 (Wilcoxon *z* scores equal to 7.9 for Aglianico and 7.5 for Falanghina). Considering the role of the sparkling wine production process information on consumer expectations (H3), the results of *Round II – Info*, when respondents assigned their expected liking scores after examination of the labels and the provision of additional information on the two winemaking processes, prove that both Champenoise wines receive statistically higher ratings, supporting the H3 hypothesis (Wilcoxon *z* scores equal to 4.9 for Aglianico and 4.1 for Falanghina). Finally, the results of *Round III – Info taste* again show that respondents prefer the Charmat-processed wines, confirming hypothesis H4 – consumer preferences for sparkling wines are influenced by hedonic liking (Wilcoxon *z* scores equal to 7.3 for Aglianico and 7.3 for Falanghina).

### WTP values

The observed pattern of consumers preferences on hedonic ratings is also confirmed when measured in monetary terms (WTP), providing further empirical evidence on the H2–H4 hypotheses. Figure 4 shows the mean WTP in euros for the four products. Findings on WTP reveal that respondents assigned significantly higher bids for Charmat sparkling wines (both Falanghina and Aglianico) in the *Round I – Blind* and *Round III – Info taste*. (WTP is not influenced by participants’ characteristics with the exclusion of income level: respondents with higher income show overall higher bids. Details are available upon request.) Figure 5 illustrates

in more detail the dominance on participants’ preferences of Charmat wines over the Champenoise ones observed in the *Round III – Info taste*. For instance, less than 30% of respondents were willing to pay more than €5 for the Champenoise sparkling wine (Falanghina), while this percentage is close to 70% of respondents for the Charmat. By setting the price at €10, only 5% of the consumers were willing to buy the Champenoise (Falanghina), while there was still 20% of participants willing to buy the Charmat at this price.

In contrast, in *Round II – Info*, after examination of the labels and the provision of additional information on the two winemaking processes and no tasting, the Champenoise wines (Aglianico and Falanghina) received a higher WTP than the Charmat wines. The observed positive effect of the information on Champenoise wines on the expected likings could also maintain an effect on consumer preferences when the respondents actually tasted the products: *Round I – Blind* identified a difference in WTP between Charmat and Champenoise of €4.07 and €4.31 for respectively Aglianico and Falanghina, in favour of Charmat (Fig. 4). These preferences for the Charmat considerably declined (€2.54 for Aglianico and €2.94 for Falanghina) in *Round III – Info taste*. This gap reduction (Champenoise versus Charmat) result was statistically significant ( $P < 0.01$ ). This result will be discussed in more detail in the next section, where the importance of the moderating effect of information and the distance between the informed liking and expected liking (disconfirmation of expectations) will be explicitly investigated.

### Dissonance and moderating effect of information

Outcomes (hedonic rating scores and revealed WTP) of the three rounds can be rearranged to explicitly identify the dissonance (DI) and the moderating effect of information (MI) of each of the four bottles. Formally, Eqns (1) and (2) refer to the conventional ‘differences estimator’,<sup>66</sup> where the differences refer to the

**Table 1.** Participants' wine-related characteristics

	Mean	SD	Scale
Sparkling wine consumption frequency <sup>a</sup>	4.42	1.52	1–7
Wine purchasing frequency <sup>a</sup>	4.69	1.94	1–7
Sparkling wine purchasing frequency <sup>a</sup>	2.93	1.67	1–7
Origin importance in wine selection <sup>b</sup>	4.21	0.65	1–5
Grape variety importance in wine selection <sup>b</sup>	4.35	0.61	1–5
Vintage importance in wine selection <sup>b</sup>	4.15	0.65	1–5
Designation importance in wine selection <sup>b</sup>	3.89	1.00	1–5
Producer awareness importance in wine selection <sup>b</sup>	3.38	0.97	1–5
Awards/prizes importance in wine selection <sup>b</sup>	3.08	0.96	1–5
Wine objective knowledge <sup>c</sup>	6.29	2.10	0–10
Wine subjective knowledge <sup>d</sup>	2.91	0.74	1–5
Wine involvement <sup>d</sup>	3.94	0.70	1–5

<sup>a</sup> Scale ranging from 1 (once a month) to 7 (every day).  
<sup>b</sup> Scale ranging from 1 (poorly important) to 7 (strongly important).  
<sup>c</sup> 0–10 scale (1 for every correct answer, 0 otherwise); reliability coefficient  $\alpha = 0.7$ .  
<sup>d</sup> Scale ranging from 1: very low to 5: very high; wine subjective knowledge reliability coefficient  $\alpha = 0.85$ ; wine involvement  $\alpha = 0.65$ .

set of measures (hedonic liking and WTP) collected in different 'treatment' conditions.

The dissonance (DI) of each of the four products and for each respondent can be calculated, subtracting the outcomes of Round I, where respondents blind tasted the wines (blind liking), from the outcomes on the expected liking collected in Round II:

$$DI (\%) = \frac{Y_{(Round II - Info)} - Y_{(Round I - Blind)}}{Y_{(Round I - Blind)}} \times 100 \quad (1)$$

DI measures the distance between expected liking and blind liking and (as a percentage from the baseline outcome Round I – Blind). The greater the DI (in absolute terms) the greater is the disagreement between the expectation and the blind judgement on the wine. A positive DI value indicates that expectations on the product goes beyond the liking in blind conditions. Measuring DI is important since, following the cognitive dissonance theory,<sup>70</sup> consumers judge the consumption overall experience being positive or negative also according to the net balance between informed liking and expected liking.<sup>71</sup>

In the presence of dissonance it is possible to observe a moderating effect of information: empirically, for each of the four wines and for each respondent 'moderating effect of information' (MI) can be calculated as

$$MI (\%) = \frac{Y_{(Round III - Info taste)} - Y_{(Round I - Blind)}}{Y_{(Round I - Blind)}} \times 100 \quad (2)$$

where  $Y_{(Round III - Info taste)}$  represents the collected outcomes (hedonic rating scores and revealed WTP) of Round III where the respondent tasted the wines observing the wine labels and being

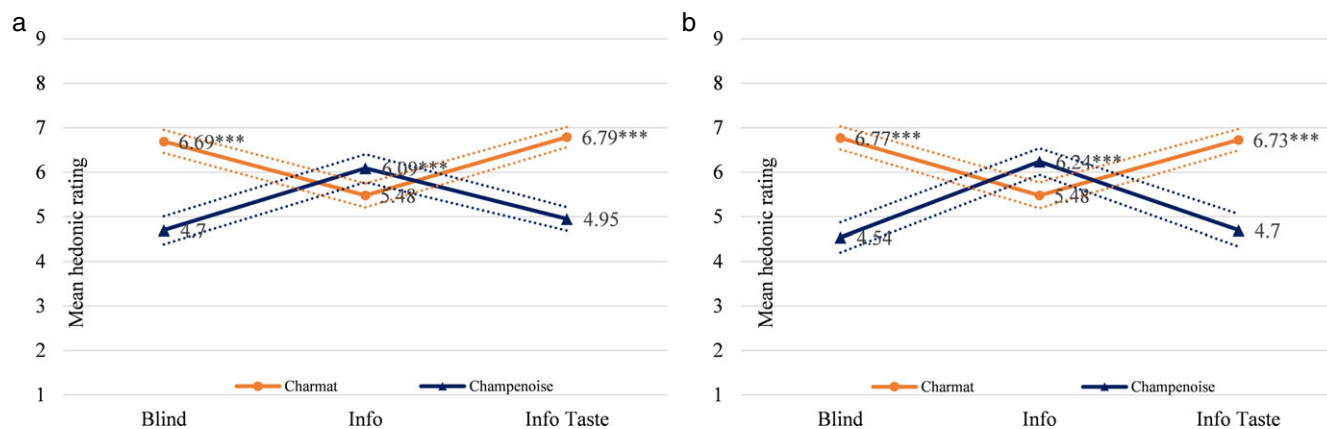
fully cognizant of the differences between the two production methods, while  $Y_{(Round I - Blind)}$  represents the outcomes of Round I characterized by the blind tasting without any supplemental information. MI captures the average effect of the information (as a percentage from the baseline outcomes – Round I – Blind) given to the respondents on the informed liking and it can be calculated for both WTP and hedonic score. We refer to a 'moderating' effect since, as previously shown, the information on the Champenoise method lowered considerably the observed preferences for the Charmat in Round III – Info taste. The result was not completely unexpected, as previous studies<sup>15</sup> have proven that information may have a relevant effect not only on expected liking of the product (Round II – Info outcomes) but also on informed liking.

Table 2 reports the average DI and average MI for both hedonic ratings and reveals the WTP for the four different wines.

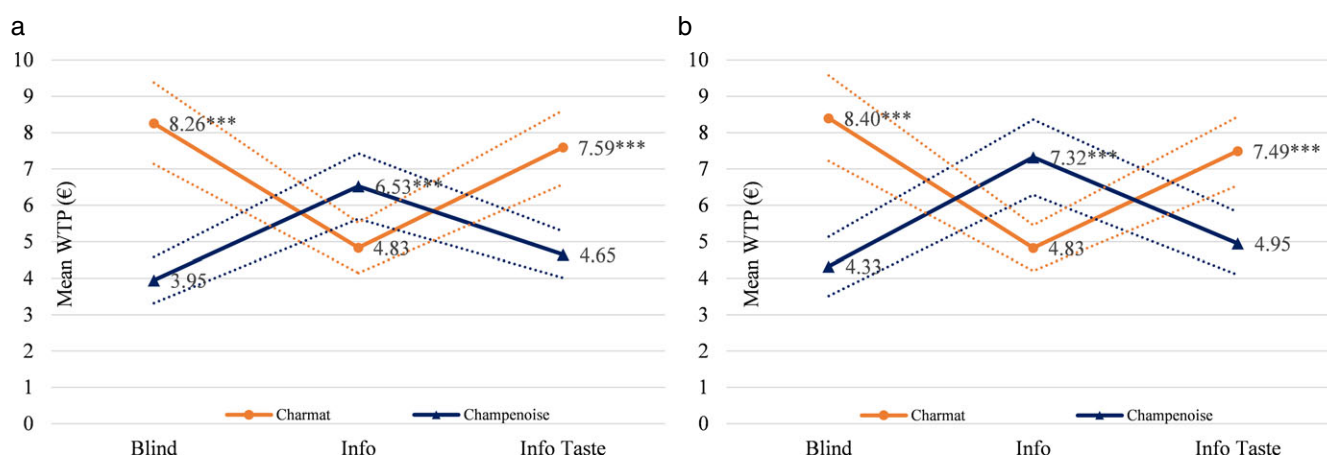
Taking into consideration WTP, the DI signs are extremely positive and statistically significant for the Champenoise products (around +65% for both) and negative and significant for the two Charmat wines (around –40%). Similarly, DIs in hedonic scores have the same directions with reduced strength. For MI, however, WTP is statistically significant and positive for the two Champenoise wines and negative for the Charmat wines (albeit just Aglianico is significant only at the 0.10 level).

## DISCUSSION

The sensory profiles of the sparkling wines obtained from the Italian native grape varieties Aglianico and Falanghina resulted in distinctive properties that depended on the method of secondary fermentation (Charmat or Champenoise). Our findings are in line with results reported in a recent study on Australian sparkling wines,<sup>49</sup> where Charmat wines were sweeter and fruity-driven, while Champenoise wines were perceived with a more complex sensory character associated with toasty, yeasty, aged/developed aromas, which can be attributed to the extended period of ageing on yeast lees. This showed that the production method has a role in determining the peculiarities of the flavour profiles, and then consumers' hedonic liking. These differences are due to the different chemical compositions of the wines obtained by the two methods, mainly in terms of volatile compounds, phenolics, polysaccharides, and proteins.<sup>45,72</sup> The hedonic ratings obtained from Round I – Blind and Round III – Info taste revealed that when experiencing the sensory quality the consumers preferred the Charmat wines, both from Aglianico and from Falanghina grapes. This could seem in contrast with the fact that sparkling wines obtained by the Champenoise method are usually considered higher quality wines, due to the strong reputation gained over time by Champagne.<sup>73</sup> However, a study conducted on Australian sparkling wines produced by the two different methods showed that the expertise of the panellists plays a role in determining the preference: the wines obtained by the Champenoise method had high-quality ratings by an expert panel, while the Charmat wines were preferred by consumers, irrespective of age, consumption frequency, or wine involvement.<sup>49</sup> Another aspect to consider is the familiarity with a certain wine style: in the study by Culbert *et al.*,<sup>49</sup> older consumers tended to like Champenoise sparkling wines more than younger consumers did, who conversely preferred lower priced, fruit-driven Charmat wines. These results were attributed to the different frequency of sparkling wines consumption, essentially determined by different disposable incomes. Our results obtained from young wine consumers (aged 18–36) are consistent with



**Figure 3.** Mean hedonic ratings in the three rounds for Falanghina (a) and Aglianico (b) wines and 95% confidence interval (dotted lines). Note: triple asterisks indicate statistically significant differences (Charmat versus Champenoise) at  $P < 0.01$  level, according to the Wilcoxon signed-rank test.

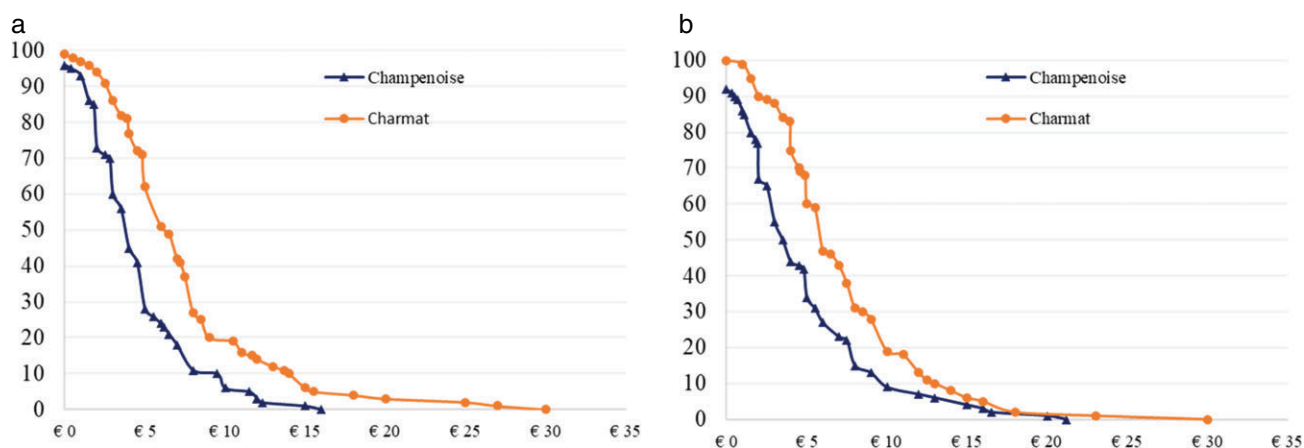


**Figure 4.** Mean WTP (€) for the Falanghina (a) and Aglianico (b) wines in the three rounds and 95% confidence interval (dotted lines). Note: triple asterisks statistically significant differences (Charmat versus Champenoise) at  $P < 0.01$  level, according to the Wilcoxon signed-rank test.

these findings. Interestingly, in the *Round II – Info*, when detailed information on the production methods was given, consumers liked the two Champenoise wines more than the Charmat wines. This could be related to the higher reputation of these products or to the presented features of the Champenoise method (i.e. long ageing time, extended contact with lees, use of ‘traditional’ materials). These positive expectations seem not to influence the sensory perception substantially in terms of liking, as the results of the *Round III – Info taste* suggest, being only slightly different to those obtained in *Round I – Blind*. On the contrary, a previous study revealed a clear influence of expectations on the sensory perception of wine.<sup>36</sup> However, in that study, a single wine with different information (positive or negative) was considered; therefore, the judges faced wines with exactly the same sensory profile. We could hypothesize that, in our case, the sensory experience overwhelms the expectation in determining the liking, due to the existence of great sensory differences, as found by quantitative sensory analysis of the experimental wines.

WTP reflected the trend of hedonic scores among the three rounds. However, when calculating the gaps between WTP-Charmat and WTP-Champenoise for each varietal wine, a reduction was registered in *Round III – Info taste* with respect to *Round I – Blind*. This reduction of the gap (Champenoise versus Charmat) could be ascribed to the interaction of the production

process information and the experienced quality, supposing that the information mitigates the importance of experienced quality on consumers’ preferences (a formal statistical test provided empirical evidence of the given speculative interpretation). However, this result was observed only on WTP and not on hedonic ratings. As with every empirical study, the current research also faces a number of limitations. Foremost is that the specific sparkling wines tasted and the particular group of participants (young adults) does not allow a generalization of the results. In addition, several aspects related to the experimental auction mechanism foster specific biases; for example, the compensation fee (necessary in this type of experiment) or the number of products auctioned might influence participants’ hedonic scores and WTP.<sup>74,75</sup> In addition, in using a within-subjects design, the role of one specific attribute cannot be absolutely isolated (i.e. the progressive treatment rounds create an information saliency bias that confounds the effects of each round, reinforcing the effect of information).<sup>76</sup> Furthermore, the intrinsic nature of experimental auctions makes them prone to the so-called top dog effect; that is, participants submit high bids only for the sake of winning the auction. This impacts on the products’ WTP however, but not on the differences between processes.<sup>63,77</sup> Finally, specific information on buying and consumption frequencies of Charmat and Champenoise sparkling wines were not recorded in the data



**Figure 5.** Relation between price and share of respondents willing to purchase Champenoise and Charmat sparkling Falanghina (a) and Aglianico (b) wines (Round III -- Info taste).

**Table 2.** Dissonance (DI) and moderating effect of information (MI) on hedonic ratings and WTP (% change)

	Hedonic rating		WTP	
	DI	MI	DI	MI
Falanghina Champenoise	29.6*** (6.20)	5.3*** (2.87)	65.3*** (5.99)	17.7*** (3.39)
Falanghina Charmat	-18.1*** (-5.83)	1.5 (0.45)	-41.4*** (-6.55)	-8.05 (-1.50)
Aglianico Champenoise	37.4*** (6.58)	3.5 (1.50)	69.1*** (6.03)	14.35** (2.11)
Aglianico Charmat	-19.1*** (-5.95)	-0.6 (0.72)	-42.5*** (-6.35)	-10.75* (-1.76)

\* $P < 0.1$ ;  
\*\* $P < 0.05$ ; \*\*\* $P < 0.01$ .  
Wilcoxon z scores in parentheses.

gathering, and thus explicit relations with preferences cannot be inferred.

## CONCLUSION

This study analysed to what extent the production process can affect both consumers' quality expectations and perceptions. A specific experimental design was implemented based upon a combination of hedonic evaluations with experimental auctions under different information scenarios, testing a set of different hypotheses. Empirical evidence reveals the importance of the production process on consumers' preferences. The production process impacts both the sensory profile of sparkling wines and consumer informed liking; information on the sparkling wine production process influences consumer expectations; and finally, consumer preferences for sparkling wines are clearly influenced by hedonic liking. These findings support the increasing amount of studies revealing that blind tastings challenge commonly held perceptions about consumers' wine preferences.<sup>78</sup> Moreover, our paper sheds light on the role of information in moderating the

impact of experienced quality on consumers' preferences. In particular, it emerged that detailed information on the Champenoise method is perceived as positive, thus increasing expected liking and WTP of young consumers. In light of this, intensive advertising and communication campaigns might significantly affect young consumers' quality expectations and perceptions and also their willingness to buy Champenoise sparkling wines. Furthermore, the increasing degree of familiarity with this wine typology could have a positive effect on the liking (both expected and informed).<sup>49</sup> Several practical implications stem from our findings. Wine producers should carefully tune the information conveyed and the specific product characteristics, both in terms of sensory profile and in terms of acquired market reputation. Moreover, wineries could run information campaigns to increase awareness of the differences in the sensory profiles of Charmat and Champenoise products, to differentiate further their product portfolio.

This study should be extended to older consumers in order to compare these results obtained for young adults with other cohorts of wine drinkers. Furthermore, given the limited buying power of young individuals, other cohorts might purchase more expensive wines; therefore, prior experience with higher quality sparkling wines could be higher. Further analysis could also more deeply investigate the peculiar sensory attributes that drive consumer preferences for specific sparkling wines. These studies would provide wine producers valuable, practical, information about the main cues able to affect the perceived quality of their wines to tailor products and specifically target particular consumer segments. Finally, wineries would acquire useful guidelines for their marketing efforts from studies that consider the interactions in the consumer's purchasing decision of a greater amount of wine attributes (e.g. producer/brand reputation, label aesthetics, back label information) and shopping environment stimuli (i.e. store promotions, display on shelf, shelf talker).

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## APPENDIX A: SPARKLING WINES PRODUCTION PROCESSES

The base wines (100% Aglianico and 100% Falanghina) were produced according to a standard protocol of vinification (vintage 2014) and secondary fermentation was conducted by the Champenoise or Charmat method, as described in the following.

### Champenoise method

To 5 hL of each base wine (Aglianico and Falanghina), the *liqueur de tirage* (sucrose/base wine 650 g L<sup>-1</sup>) was added just before yeast inoculation, in order to obtain a final sugar concentration of 24 g L<sup>-1</sup>. The yeast inoculum (*Saccharomyces bayanus*) was acclimated before addition to the base wines. Briefly, acclimation consisted of three phases: (i) rehydration in a sugar solution (50 g L<sup>-1</sup>) at 32 °C for 1 h; (ii) addition to yeasts in phase A of the base wine, *liqueur de tirage* and a solution of ammonium salts (10 g hL<sup>-1</sup>) in a ratio 1 : 1 : 1 : 1 (24 h at 25 °C); (iii) addition to yeasts at the phase B of base wine, *liqueur de tirage* and a solution of ammonium salts (5 g hL<sup>-1</sup>) in a ratio of 1 : 2.5 : 0.75 : 0.75 (48 h at 20 °C). The acclimated yeast inoculum was then added to the base wines, along with 25 g hL<sup>-1</sup> of ammonium salts and 3 g hL<sup>-1</sup> of bentonite. The wines were bottled in 750 mL bottles and sealed with crown

caps possessing a polyethylene bidule. The second fermentation and ageing on lees took place at the cellar temperature (approximately 10–15 °C) for a total period of 15 months. Before sensory analyses and experimental auctions, the yeast lees were eliminated by hand from the bottles.

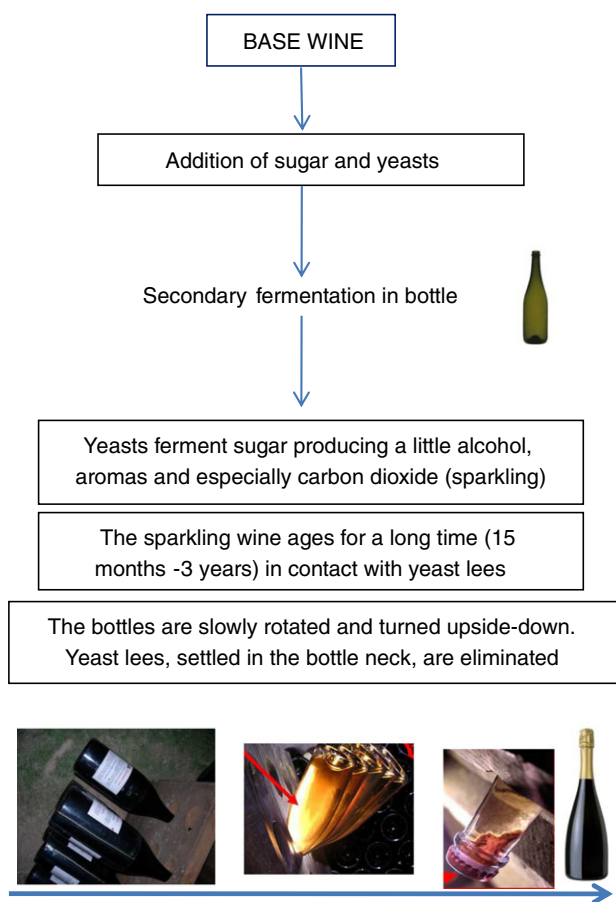
### Charmat method

To the base wines (Aglianico and Falanghina), sucrose (24 g L<sup>-1</sup>), yeast autolysate (15 g hL<sup>-1</sup>) and a mixture of ammonium salts and thiamine (5 g hL<sup>-1</sup>) were added. The yeast inoculum (*S. bayanus*) was prepared as previously described and added in the fermentation tanks, where secondary fermentation took place at 14–16 °C for 15 days. After 4 months of maturation on yeast lees, wines were filtered and bottled.

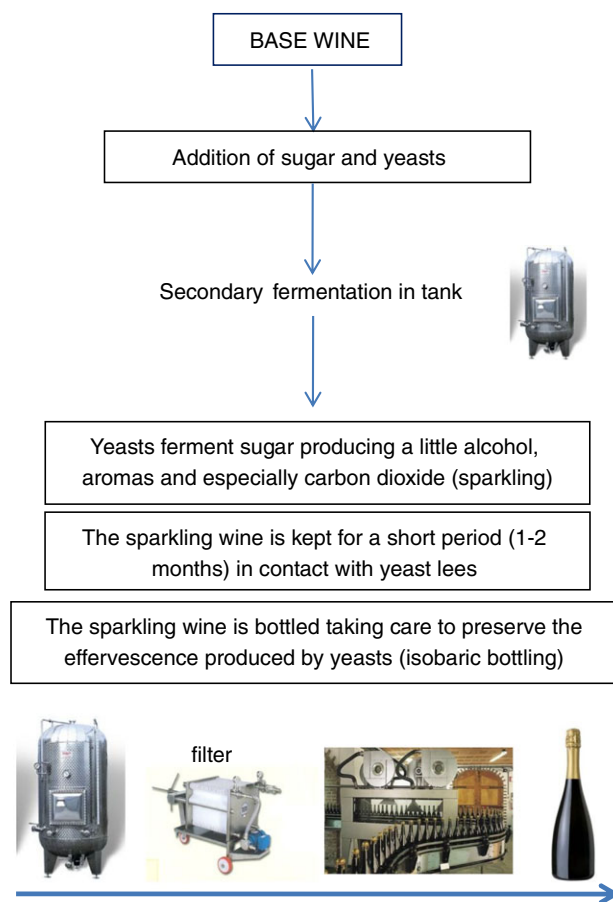
## APPENDIX B

Handout with information on the production methods, presented in the *Round II – Info*. Half sample of participants received the current version, the other half received the same handout but with the Charmat method presented on the left. Order had no impact on WTP in the information round.

### Champenoise method Time: 15 months - 3 years



### Charmat method Time: 1 month - 5 months



## APPENDIX C: QUESTIONS USED TO MEASURE WINE KNOWLEDGE AND INVOLVEMENT

Thinking about wine, we ask you to express your level of agreement with the following opinions using a scale from 1 to 7, where 1 means 'Strongly disagree' and 7 'Strongly agree'.

	Strongly disagree	1	2	3	4	5	6	7	Strongly agree
Q.1 I feel quite knowledgeable about wine									
Q.2 Among my friends, I am one of the 'experts' on wine									
Q.3 I rarely come across a wine that I have not heard of									
Q.4 I know pretty much about wine									
Q.5 I do not feel very knowledgeable about wine									
Q.6 Compared to most other people, I know less about wine									
Q.7 When it comes to wine, I really do not know a lot									
Q.8 I have heard about most of the new wines that are around									

## APPENDIX D: TEST OF OBJECTIVE WINE KNOWLEDGE

The following questions are adapted from Vigar-Ellis *et al.*<sup>65</sup>

Question	Answer choices (correct choice in bold)
Which of the following is a red wine?	<b>Corvina</b> , Trebbiano, Vermentino, Glera, Do not know
A peppery character is most associated with which wine?	Merlot, <b>Shiraz</b> , Nero d'Avola, Pinot Noir, Do not know
Which is not a famous French wine region?	Bordeaux, Champagne, <b>Rheingau</b> , Alsace, Do not know
What is Amarone?	<b>A wine</b> , A plum based liquor, A bitter liquor, A grape variety, Do not know
Which of these wines is typical and produced in Tuscany?	Nero d'Avola, Barolo, <b>Chianti</b> , Soave, Do not know
In which region is Prosecco produced?	<b>Veneto</b> , Liguria, Piemonte, Alto Adige, Do not know
What does DOCG mean?	Denominazione di origine corretta e garantita, Denominazione di origine certificata e garantita, <b>Denominazione di origine controllata e garantita</b> , Denominazione di origine climatica e geografica, Do not know

Question	Answer choices (correct choice in bold)
Which region is the largest producer of wine in Italy?	Tuscany, Apulia, Sicily, <b>Veneto</b> , Do not know
What is Marsala?	An aromatized wine, <b>A raisin wine</b> , A sparkling wine, A fortified wine, Do not know
What is malolactic fermentation?	<b>Malic acid is converted in lactic acid</b> , Malic acid is converted in sugar, Malic acid is converted in alcohol, Alcohol is converted in malic acid, Do not know

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