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Exploring consumers' perception and willingness to pay for "Non-Added Sulphite" wines through experimental auctions: A case study in Italy and Spain ☆

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Abstract

Although scientific literature is still uncertain towards the real causes that can link headache episodes with moderate wine consumption, a growing proportion of consumers seems to address sulphites as possible culprits. Hence, the objective of this study is to assess consumers` willingness to pay for wine bearing a sulphites-free label in two traditional wine producing countries, Italy and Spain. The methodological framework is based on the specification of the Becker-DeGroot-Marschak (BDM) type of auction applied to consumers purchasing wine in the supermarket stores of both countries. A left censored Tobit model is used to analyse the bidding behaviour for conventional and "Non-Added Sulphite" (NAS) wine. Results in both countries show that consumers who link the headaches with the consumption of sulphite are willing to exchange the habitually consumed bottle of wine with a NAS wine and pay extra premium prices.

Keywords: Experimental auctions; Non-added sulphite wines; Consumer behavior

1. Introduction

Within the wine markets, consumer behaviour and preferences have been affected with deep structural changes towards higher quality wines, healthier production processes and new ways of tourism (Bregoli et al., 2016). Although it is proven that a moderate wine consumption promotes health benefits such as improving glucose tolerance, insulin sensitivity and hepatic steatosis (Rosenzweig et al., 2017), other discussions related to sulphur and its organic compounds seem to abound in both scientific literature and wine speeches (Laganà et al., 2017; Machado et al., 2009; Vecchio et al., 2017). Wine is not treated with sulphur but, at best, with sulphur dioxide (SO_2), which originates from sulphur combustion. A reaction with liquids creates sulphurous acid, which is partially present as its salts, called sulphites. The terms sulphur dioxide, SO_2, sulfuric acid and sulphites are interchangeable in common usage, while the trivial definition "sulphur" does not reflect in a proper way the chemical. The anti-microbial, antioxidant and preservative effects of sulphites were already known and used in the wine making areas of central Europe since at least the middle ages. Sulphites are formed naturally during the fermentation phase (Chengchu et al., 2006), and common quantities around 30–90 ppm (ppm) are also added throughout the production phase (Burgstahler and Robinson, 1997) to prevent spoilage and enhance aging potential (Goode and Harrop, 2011). With the development of technological and oenological knowledge combined with changes in customer preferences, the use of additional sulphites is being subjected to increasingly tight constraints, and significantly being reduced. The maximum permitted values of SO_2 were increasingly reduced especially on the basis of toxicological considerations. In many cases the

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effects of sulphite on health are very mild; however, depending on the subjects, sulphites can induce severe reactions, including respiratory and gastrointestinal set of symptoms (Lester, 1995), as well as dermatological signs and headaches (Costanigro et al., 2014). Indeed, a small percentage of the population is sensitive to sulphur dioxide to ingestion but studies revealed that the role of sulphites has been occasionally overestimated, as in the case of wine-sensitive asthmatics (Vally and Thompson, 2001). The practical justification for these reflections, in fact, is poorly founded, because around 2000 mg of SO_2 are created every day in the human body via the decomposition of proteins; this sulphur dioxide is then transformed into sulphate and expelled as such with urine. Daily consumption of a bottle of wine, with an average of 100 mg of SO_2, increases the natural transformation of SO_2 in the body of 5% more or less, which should not cause toxicological problems. Despite uncertainty, apparently consumers are increasingly convinced that the cause behind their "malaise of the next day" and their headaches could be the chemical in question (Costanigro et al., 2014) and its inorganic compounds. Even though, there is a growth of evidences in newspaper and other related topic articles who announce that consumers keep manifesting episodes of headaches and migraines after drinking moderate amounts of wine, especially red variant (Gaiter and Brecher, 2000; Robin, 2010). Until recently, there is no scientific evidence proving the veracity and it's still unclear what could be the cause. A previous study of Jarisch and Wantke (1996) stated that "histamine as a cause for headache should be considered first", but since then scholars proved that a large amount of chemicals can be the real cause (see Mauskop and Sun-Edelstein (2009), and Millichap and Yee (2003)). Others believe that the "consumption" of sulphites is the starting point of their malaise (Gaiter and Brecher, 2000) most probably due to the level of knowledge and awareness that seem to be still low. Despite the fact that the difference between non-added sulphite wines and organic wines is still unclear in consumers' eyes (Costanigro et al., 2014), scientific literature on organic wine industry has mainly focused on market trends and on consumer attitudes and purchase intentions (Pomarici and Vecchio, 2014; Pomarici et al., 2015; Remaud et al., 2008; Sogari et al., 2015). In addition, few studies that examine consumer attitudes towards organic wines (e.g., Olsen et al., 2012) provide little information about the consumers' perception of sulphite and willingness-to-pay (WTP), especially since the organic production is linked to higher quality, healthier, tastier and more socially and environmentally responsible attributes (Fotopoulos et al., 2003). In addition, even though numerous studies in the scientific literature have used experimental auctions for sustainability and certification topics (De Magistris et al., 2015; Del Giudice et al., 2016), and taking into account that wines without added sulphites could prove to be a profitable niche market, to the best of our knowledge, scant literature exists on consumers' willingness to pay for sulphite free labelling (Costanigro et al., 2014; D'Amico et al., 2016). A study of Costanigro et al. (2014) in the USA reports that a group of headache-syndrome-suffer (HSS) consumers after being informed on sulphites in wine, are willing to pay a price premium of $1.23 to avoid them, meanwhile only 3.4% of the same group of consumers are more likely to purchase a wine with non-added sulphites (NAS). A more recent study of D'Amico et al. (2016), on the Italian consumer analyzing the interest and the WTP for organic wine with NAS found that the majority of respondents (54,5%) were not willing to pay a premium or only a small premium (10%) for NAS. The study also identified that insufficient information is a barrier to higher WTP for organic NAS wine, and that the organic certification of wines *per se* is not sufficient to ensure consumers health factors. Hence, there is a need to investigate the role of subjective and objective knowledge in determining consumer willingness to pay related to wine additives and particularly sulphites. Therefore, this study analyses consumer preferences and estimates the willingness to pay for wine bearing a free sulphites additive label in two traditional wine producing countries, Italy and Spain. To achieve the main objective of comparing the marginal preferences and price differentiation between NAS wines and classic wine categories we base the methodological framework on the specification of the Becker-DeGroot-Marschak (BDM) type of auction. This type of mechanism is found to be particularly suitable for estimating the willingness to pay for with a certified absence of sulphites and is applied to 240 purchasing wine consumers in the supermarket stores of both countries.

This article is organized as follows: section two reviews the materials and method of the research, including a description of the experimental auctions, the experimental procedure and the econometrical model used; section three illustrates the results obtained and section four presents the discussions and concludes.

2. Materials and methods

2.1. Experimental auction

Experimental auctions are useful tools used by economists, psychologists, and marketing experts to determine the possible success or failure of a hypothetical entry of new products in the real market. Experimental auctions are commonly used to elicited consumers' preferences due to their incentive compatibility properties. In other words, they provide an incentive to subjects to state their true preferences in contrast to hypothetical elicitation procedures. In a typical experimental auction, subjects bid to obtain one or more goods and the highest bidder(s) have to buy the auctioned product and pay a price that is determined in the auction. This mechanism is also used to evaluate the effects of: (a) different priming strategies; (b) different information messages and (c) different vehicles of information, upon WTP (De Magistris et al., 2015; Jacquemet et al., 2013; Lusk et al., 2004). With respect to the agri-food marketing sector, this tool is used for the assessment of food safety attributes (Thorne et al., 2017), sensory and organoleptic attributes (Hung and Verbeke, 2017) and sustainability characteristics of food products (Vecchio and Annunziata, 2015).

Compared to other methods, the advantage of experimental auctions is that people are placed in an active market environment (although organized); a real market, with real money and real products can involve people revealing their preferences, while keeping the attention of individuals facing the task of evaluation. Experimental auctions help to determine the individual's willingness to pay because the mechanism requires that each participant make an offer that, in theory, reflects the value he attaches to the good auctioned.

The incentive-compatible BDM type of auction (Becker et al., 1964) was selected as it is particularly suited to eliciting WTP directly at the point of purchase, thereby enhancing external validity (Wertenbroch and Skiera, 2002; McDaniel and Gates, 2001). In addition, the BDM was selected among other demand-revealing valuation mechanisms (e.g., Vickrey or nth-price auctions) because the experiment setting required one participant at a time, a situation for which only the BDM is appropriate. Therefore, in store, non-hypothetical experimental auctions (Costanigro et al., 2011; Nayga et al., 2006) were conducted in the "wine and liquors" lane of two supermarkets in Zaragoza (Spain) and Naples (Italy) in June and July, 2016. The BDM mechanism equally penalizes over- and underbidding (Lusk and Shogren, 2007) and reduces the psychic benefit from being declared the winner of an auction (Corrigan and Rousu, 2006). Furthermore, the BDM auction tends to provide relatively strong incentives for truthful bidding for all individuals regardless of the magnitude of their true WTP (Lusk et al., 2007). Finally, compared to other auction mechanisms the BDM, in its endow-upgrade format, is also very easy to explain (i.e. participants need only to place one bid) and most of the time one example is enough to check for participants' comprehension (Combris et al., 2009). In the endow-upgrade BDM auction format, participants have a dominant strategy in bidding an amount equal to their true valuations for the good. In particular, participants were carefully explained that they had to submit a monetary value that she/he would be willing to pay. In order to win, participants had to submit a bid greater than or equal to a randomly extracted binding value, which was randomly drawn, for every participant, from a distribution of values unknown to the subjects (Bohm et al., 1997) to avoid anchoring and ensure that they stated their real willingness to pay. If the exchange was made, the subject had to pay the binding value to make the exchange. On the contrary, if the subject's bid was lower than the binding value, the transaction did not happen (Lusk and Shogren, 2007). Since previous scholars have noted that for BDM auctions training rounds are not required (Feldkamp et al., 2005), none was used in this research. The distribution of potential "prices" was uniform and based on real market prices, ranging from 0 cents (€) to 3,50, in increments of 10 cents.

2.2. Experimental procedure

The experiments have been conducted throughout a three-week period in each country and in three different phases of the day (early morning, afternoon and evening) (East et al., 1994). In each session, an interviewer approached subjects individually. In particular, participants were randomly recruited while they were actually purchasing a bottle of wine from the supermarket shelves. In order to be eligible for the study, each participant had to be aged 18 or above and consume wine at least once a month. Each respondent was rewarded with a bottle of conventional wine, averagely priced 4,5€ in both countries, for participating in the experiment. On average, about 70% of the contacted wine consumers agreed to participate. The experimental protocol consisted of a pencil-and-paper questionnaire and a WTP experiment for those who wanted to upgrade the conventional bottle of wine with a "Non-Added Sulphites" wine.[1] It took approximately 15 min for each participant to complete the experiment, including a careful explanation of BDM auction mechanism. Respondents were randomly assigned in two different treatments. The endowed bottles of wines were red or white variant, depending on customer's habitual wine purchase at that moment, since we also wanted to test whether there is a different perception between these two varieties. Then, following Costanigro et al. (2014), participants were asked if they have ever experienced headache after drinking moderate amounts of wine, without directly referencing sulphites. "Moderate consumption" was emphasized to ensure that participants would not confuse their post-consumption headache with alcohol hangover; in case of affirmative response to the previous question, participants were asked to choose one or more perceived causes of their headache from a randomly ordered list of factors (dehydration, histamines, tannins, organic wines, red wines, tyramine, white wine, sulphites and other). After this task, individuals completed a self-report questionnaire on wine subjective knowledge (following Flynn and Goldsmith (1999)). Subsequently, respondents were handed the NAS wine bottle, prepared in order to avoid any external differences with the conventional one (same format of the bottle, vine variety, vintage, closure and label), and were asked if they were interested in exchanging their endowed bottle of wine (conventional) for a NAS one. In case of affirmative response, the BDM auction mechanism started, otherwise their negative response was recorded as a willingness to upgrade the bottle equals to 0 and proceeded with the second part of the questionnaire. Subsequent to the WTP experiment, participants were asked to complete a second short questionnaire explicitly developed to analyse which are the main personal traits that can explain their willingness to pay a premium price for the "non-added sulphite" wine bottle. Items were shown as it follows:

- Participants' subjective knowledge on sulphite (e.g., "I'm able to distinguish the presence of sulphite in wine").
- Attitude towards naturalness and healthy food ("health" subscale adapted from the Food Related Life Style Scale – Grunert, 1993).
- Label's use, reading and trust (Krystallis et al., 2012).
- Objective knowledge about sulphites (i.e. we used questions in order to assess the specific knowledge of participants towards sulphites).

[1] The Non-Added Sulphites bottles of wines were presented with a logo impressed on the front label.

- Wine consumption habits.
- Socio-demographic data.

At the very end of the questionnaire participants were asked their perceived value of the endowed bottle.

2.3. Econometric model

Since the aim of this research is to investigate factors affecting WTP for NAS wines, the dependent variables in the model are the bids declared by each subject. Considered the nature of the data, a left censored Tobit (Robin, 1958) model was used to analyse the bidding behaviour for B_i^w ($i=1$ and 2, conventional and NAS wine). Censoring at zero is a common feature of experimental auctions in some recent studies (Bernard and Bernard, 2010; Shi et al., 2013) in which Tobit is used to address the censoring issue. Since the main interest is focused in the most important needed effects, possible interactions were ignored. In general, the Tobit model can be expressed as:

$$y_i^* = \beta' x_i + u_i, u_i \sim N(0, \sigma^2)$$

$$y_i = y_i^* \text{ if } y_i^* > 0 \text{ or } 0 \text{ if } y_i^* \leq 0$$

Therefore, the expected willingness to pay for consumer i can be computed as:

$$\begin{aligned} E(y_i^*) &= E(y_i|y_i>0)\tilde{n}f(y_i|y_i>0) + E(y_i|y_i=0)\tilde{n}F(y_i=0) \\ &= \left[\beta' x + \sigma\lambda\left(\frac{\beta' x_i}{\sigma}\right)\right]\tilde{n}\Phi\left(\frac{\beta' x_i}{\sigma}\right) + 0 \\ &= \beta' x_i \Phi\left(\frac{\beta' x_i}{\sigma}\right) + \sigma\varphi\left(\frac{\beta' x_i}{\sigma}\right) \end{aligned}$$

where the inverse Mills ratio $\lambda(\beta' x/\sigma)$ is equal to $\varphi(\beta' x/\sigma)/\Phi(\beta' x/\sigma)$ and the marginal effect (β) for the continuous variable x_j is:

$$\frac{\partial E(yi)}{\partial xj} = \Phi\left(\frac{\beta' x_i}{\sigma}\right)\beta_j$$

In particular, the independent variables are participants' socio-demographic and lifestyle characteristics, consumption frequency of wine, subjective wine and sulphite knowledge.

3. Results

3.1. Sample description

The socio-demographical results of Italian and Spanish populations are showed in Table 1. With regard to the Italian sample, participants (55,8% of females) were in the range 20–77 years (32,7 ± 10.8 years), living in a medium-size household (3,8 ± 1,3 members); 10% of the sample had a household income higher than 4000€ per month, while for more than 55% it was lower than 2000€ per month. About a quarter had a University degree (27,2%), while more than 60% is employed. In the Spanish sample, participants' age (50,8% males) ranged between 18–82 years (45,9 ± 15,2 years) living in medium-size households (2,9 ± 1,3 members), mostly employed (62%) and with an average income ranging between 2000 and 4000€ per month.

Table 1
Descriptive Statistics of the sample.

Variables	Italy	Relative Frequencies (Mean)		
		Official Stats[a]	Spain	Official Stats[a]
Age				
Mean value	32.7 (SD = 10.8/ min-max 20–77)	44,2	45.9 (SD = 15.2/ min-max 18–82)	41,9
18–34	76%	18.1%	25.8%	19.8%
35–54	18%	30.6%	46.7%	32.2%
55–74	5%	23.6%	24.2%	21%
More than 74	1%	11.3%	2.5%	9.2%
Gender				
Female	55.8%	51,4%	49.2%	50,9%
Male	44.2%	48,6%	50.8%	49,1%
Household Members	3.8 (SD = 1.3/ min-max 1–8)	2,35	2.9 (SD = 1.3/ min-max 1–9)	2,52
Education Level				
At least High school degree	63.3%	59.3%	55.8%	56.6%
Bachelor's degree or higher	10.1%	/	21.7%	/
Employment status				
Employed	65%	56.8%	62%	56.5%
Unemployed	35%		38%	
Monthly Income				
Mean value (NET)	/	2,033 €		1,718€
Less than 1,000€	10.9%		11.7%	
Between 1,000 and 2,000€	45.8%		35.9%	
Between 2,000 and 4,000€	33.3%		48.3%	
More than 4,000€	10%		4.2%	

[a]OECD and Eurostat databases: data refers to 2015.

3.2. Explanatory variables

The exploratory variables were captured through the questionnaire who aimed in defining which variables explain consumers' willingness to pay. Scales Cronbach's alpha indicates a consistent internal validity, ranging from 0,63 (subjective sulphite knowledge) to 0,82 (subjective wine knowledge). Observations from Fig. 1 show that subjective knowledge on sulphites in both countries is very low (mean score 2,5 ± 1,3 in Spain, 3,5 ± 1,2 in Italy). This evidence is confirmed in Fig. 2, where the objective knowledge[2] has been analysed. In fact, the mean score resulted is 0,1 ± 0,14 for Spain and 0,15 ± 0,20 for Italy, respectively.

[2]As a reminder, objective knowledge was measured with 5 questions related to sulphites (e.g., "What is the typical smell that indicates the presence of sulphites in wine?" 1 - Correct answer, 0 - wrong or "I don't know").

3.3. Willingness to pay

More than 80% of the total sample showed a positive WTP for exchanging the conventional wine bottle with the NAS one. In particular 91 consumers in Spain and 102 in Italy decided to exchange the endowed bottle. Participants then, were asked their perceived value of the endowed bottle (3,75€ for Spanish consumers, 4,90€ for Italians), this average price can be considered as the regular price for the conventional bottle which is close to the average real market price. The average WTP for exchanging the bottle resulted between 1,17€ ± 0,76€ for Spain and 0,90€ ± 0,50€ for Italy. However, since the main interest is the mean WTP for the whole sample, zero WTP values are also taken into account (Reiser and Schechter, 2009). In this later case, the mean WTP for exchanging a conventional wine with the NAS bottle of wine, drops to 0,89€ ± 0,83€ for Spanish consumers and 0,77€ ± 0,56€ for the Italian ones. According to these results, one NAS bottle of wine (750 ml) leads to a premium price of 25% in Spain and 16% in Italy. The perceived price of the two different varieties of wine does not have a statistically significant difference neither in Italy nor in Spain. In addition, the different variety of wine endowed did not significantly affect WTP in Spain (two sample t-test results, t = 0,19; prob > t = 0,84), while in Italy white variant (0,89€ ± 0,60€) obtains a significantly different price premium (t = 2,36; prob > t = 0,01) compared to the red variant (0,65 ± 0,50€).

Fig. 3 indicates that about 15% of the Italian consumers are willing to pay an additional price of 1,5 € while 10% of the sample is willing to pay a price premium of 1 € to purchase a NAS wine. In Spain, according to Fig. 4, about 20% of the sample is willing to pay a premium price of more than 1,5 €, whilst around 20% of the sample pay 1€ as an additional premium price.

The next step in the analysis was to see whether structural differences existed between headache and non-headache symptoms. Since people report that headaches are triggered from the consumption of sulphites, we anticipated that participants who suffer headache would have statistically different preferences towards the presence of sulphites in wine in comparison to those that do not experience headache issues. Table 2 summarizes the WTP inter and intra country mean values divided in three groups. As expected (Group 1) who do not experience headache after a moderate consumption of wine and (Group 2) who do not associate sulphite as a possible cause of their headache are willing to pay less premium prices in both countries in comparison to (Group 3) that directly link headaches with the presence of sulphites in wine. In particular the difference in terms of WTP almost doubles in (Group 3).

Comparing the WTPs of (Group 1) which range between 0,63 ± 0,48€ for Italy and those of (Group 3) who link headache with the presence of sulphites 1,19 ± 0,60€ we estimate an additional increase of 89% ± 25% respectively. On the other hand, comparing (Group 1) WTPs with (Group 3) for the Spanish consumer, we estimate an additional increase of 91% ± 38% respectively. In general terms, the Spanish consumer who associate the headache symptoms with the presence of sulphites in wine is willing to pay 2% more than the same group of the Italian consumer.

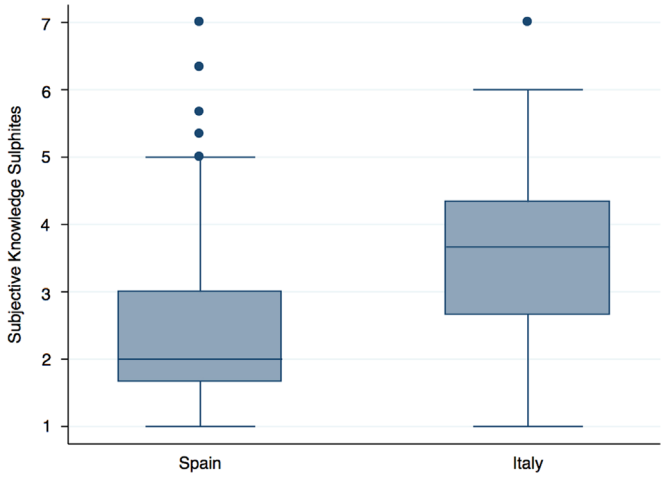

Fig. 1. Subjective Knowledge about Sulphites.

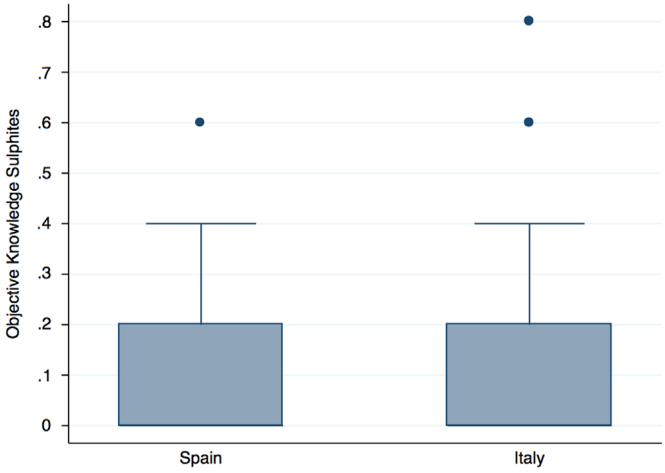

Fig. 2. Objective Knowledge about Sulphites.

3.4. Econometric estimates

Before considering which are the main drivers that leads to a premium price, a logit model was performed in order to understand if there are specific variables that could explain consumers' entrance in the market. Table 3 reports the parameter estimates of a logistic regression, aggregated for both countries. A "participation dummy variable" was created taking the value of 1 = participating and 0 = otherwise. In particular, this choice is being explained by the behavioural and psychographic variables of "naturalness" and "sulphite objective knowledge", followed by two socio-demographic characteristics (age and gender).

Once the variables that determine market entry are discriminated, the next step is to apprehend which variables influence consumers' willingness to pay. For that reason, a

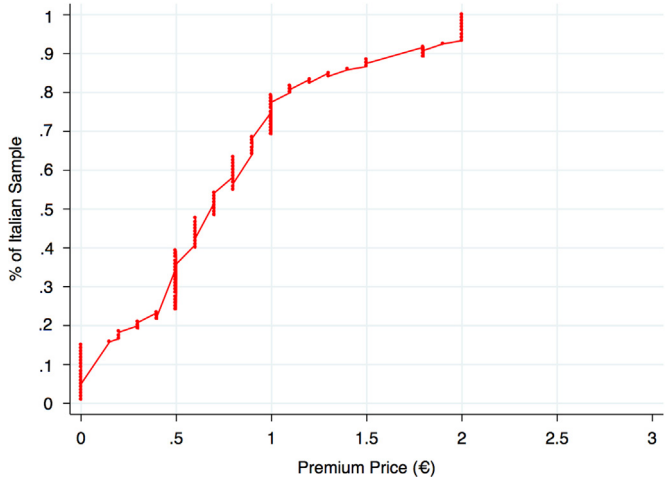

Fig. 3. Relation between price premium and willingness to purchase NAS wine among Italian consumers.

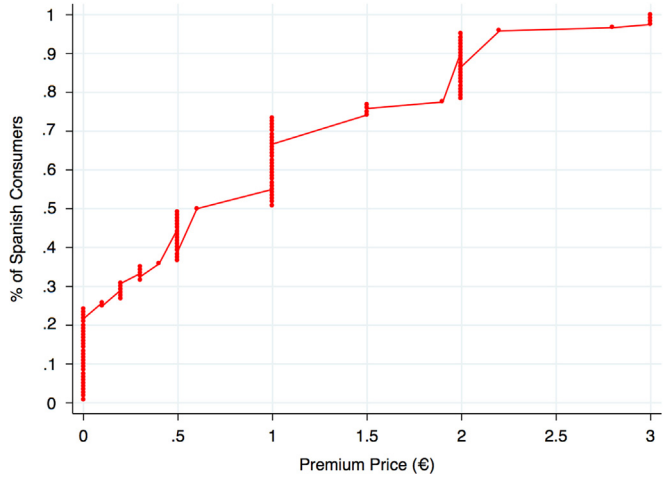

Fig. 4. Relation between price premium and willingness to purchase NAS wine among Spanish consumers.

Tobit model was performed and specified as follows:

$$WTP_i = \alpha + \beta_1 * (Headache\ cause : sulphites)_i + \beta_2 * (Naturalness)_i + \beta_3 * (Subjective\ Wine\ Knowledge)_i + \beta_4 * (Subjective\ \ Sulphite\ Knowledge) + \beta_5 * (Age)_i + \beta_6 * (Gender)_i + \beta_7 * (Wine\ Purchasing\ Frequency)_i + \beta_8 * (Wine\ Variety)_i + \varepsilon_i$$

Where WTP_i is the average WTP for the ith consumer. The explanatory variable "Headache cause: sulphites" is introduced as dummy variable taking the value of 1 = if sulphites causes headache and 0 = otherwise. The variable "Naturalness" enters the model as mean values of 3 items measured in a 7-point Likert scale. The "Subjective Wine Knowledge" and "Subjective Sulphite Knowledge" variables enter the model as mean values of 5 and 6 items measured in a 7-point Likert scale. In addition, the "Gender" socio-demographic variable is introduced as a dummy variable which takes the value of 0 = Female and 1 = male. "Age" enters as a continuous variable defined as number of years. The "Wine Purchasing Frequency" variable takes the values of 1 to 4 according to the number of times consumer purchase wine (once per month, 2–3 times per month, 4–5 times per month, 6 or more times per month). Lastly, the "Wine variety" variable that defines the experimental manipulation, takes the value of 0 = white and 1 = red.

Table 2
Price premium to purchase NAS wine among Italian and Spanish consumers.

	Italy		Spain	
	Obs.	**WTP (€)**	**Obs.**	**WTP (€)**
Group 1[a]	76	0.63 ± 0.48	75	0.82 ± 0.77
Group 2[b]	21	0.82 ± 0.57	35	0.82 ± 0.84
Group 3[c]	23	1.19 ± 0.60	10	1.57 ± 1.06

[a]Consumers who did not experience headache after moderate wine consumption;
[b]Consumers who experienced headache but did not think sulphite as a possible cause;
[c]Consumers who experienced headache and linked it to the presence of sulphites.

Table 4 present the results of the Tobit estimation parameters for NAS wine. Results show that in Spain five (age, gender, wine purchasing frequency, sulphites as perceived cause of headache and naturalness trait) out of eight parameters are statistically significant. While in Italy, only three parameters are statistically significant (gender, naturalness and sulphites perceived as a cause of headache).

Taking into account that the proposed model shows some non-significant variables, Table 5 proposes a more parsimonious model that only uses the previously significant variables of each country.

Result from the estimation of the Tobit model (Table 5) indicates that the independent variable "headache cause: sulphites" receives the highest premium price (0,58€ in Spain and 0,44€ in Italy) followed by the "Gender" dummy variable. In particular, the Spanish consumer pays a premium of −0,38 €. The negative sign means that Spanish women are more willing to pay a premium price in comparison to men. Vice versa, in Italy, this variable assumes the value of 0,25€, meaning that men are more likely to pay a premium price instead of women. "Naturalness" variable was measured on a 7-point Likert scale, we consider estimates related to a one-point increase in the respondent's stated relevance for the statement examined. In this case, an increase of one rating increases WTP by 0,22€ in Spain and 0,11€ in Italy, meaning that if a participant's score, for instance, is 5, the increase in premium price is 1,1€ in the Spanish case and 0,55€ in the Italian one (0,22*5 or 0,11*5). The "Wine Purchasing Frequency" variable was also found to be statistically significant and increases WTP by 0,28€ in Spain and 0,09€ in Italy. It is worth mentioning that the "Age" variable in the Spanish case shows a decrease of the premium price as age increases by −0,2€ for each year increment. This is in contradiction to previous theories who state that older people tend to consume less quantity but higher quality food products in comparison to younger people.

Table 3
Logit parameter estimates.

Variables	Coeff.	z
Headache cause: sulphites	1.47	1.38
Naturalness	0.62***	4.10
Subjective Wine Knowledge	−0.09	−0.50
Subjective Sulphite Knowledge	−0.24	−1.31
Age	−0.03**	−2.45
Gender	−0.16**	−0.42
Wine Purchasing Frequency	0.36	1.59
Sulphite Objective Knowledge	2.59*	1.89
Number of observations	*240*	
Likelihood-ratio chi²	*40.65*	

***p < 0.01.
**p < 0.05.
*p < 0.1.

Table 4
Tobit parameter estimates on bids for NAS wine.

Variables	Spain		Italy	
	Coeff.	t	Coeff.	t
Headache cause: sulphites (DUMMY – 0=No)	0.58*	1.84	0.46***	3.46
Naturalness (1–7 = lower to higher)	0.22***	3.00	0.12**	2.47
Subjective Wine Knowledge (1–7 = lower to higher)	−0.33	−0.38	−0.04	−0.69
Subjective Sulphite Knowledge (1–7 = lower to higher)	−0.02	−0.26	−0.01	−0.21
Age (Continuous)	−0.02***	−3.20	−0.005	−1.20
Gender (DUMMY - 0=female)	−0.38**	−2.10	0.28***	2.63
Wine Purchasing Frequency (1–4 = lower to higher)	0.28***	2.82	0.08*	1.51
Wine Variety (0 = white; 1 = red)	−0.12	−0.68	−0.11	−1.06
Likelihood-ratio chi²	*31.88*		*31.20*	
Number of observations	*120 each country*			

***p < 0.01.
**p < 0.05.
*p < 0.1.

Table 5
Tobit parameter estimates on bids for NAS wine.

Variables	Spain		Italy	
	Coeff.	t	Coeff.	t
Headache cause: sulphites (DUMMY – 0=No)	0.58*	1.83	0.44***	3.26
Naturalness (1–7 = lower to higher)	0.22***	2.98	0.11**	2.28
Age (Continuous)	−0.02***	−3.19	/	/
Gender (DUMMY – 0 = female)	−0.38**	−2.13	0.25***	2.45
Wine Purchasing Frequency (1–4 = lower to higher)	0.28***	2.88	0.09*	1.70
Pseudo R²	0.198		0.226	
Likelihood-ratio chi²	31.73		29.05	
Number of observations	120 each country			

***p < 0.01.
**p < 0.05.
*p < 0.1.

4. Discussion and conclusions

The main objective of this study was to determine the premium price that Italian and Spanish consumers are willing to pay in order to limit the presence of sulphite in wine, focusing on consumers who experience headache after drinking moderate amounts of wine. The results of this study will be provided to the industry in order to deduce the existence of market niches for wine without sulphites. In our study, experimental BDM auctions were carried out to measure factors affecting WTP for NAS wines in two traditional wine producing countries, Italy and Spain. Results show that consumers seem to appreciate the reduction of sulphite in their wine, especially in the case when they suffer headache, despite the causes of that sore head in the literature are still unknown and regardless of the variety, differently from literature where the red variety has been addressed as main responsible (Gaiter and Brecher, 2000; Robin, 2010). Almost 40% of the total sample (240 respondents) who stated to suffer headache after a moderate wine consumption and who believe that sulphites is the cause of that, are willing to pay an additional price premium of 1,19€ in Italy and 1,57€ in Spain in order to exchange the bottle endowed with a no-added sulphite wine. Therefore, an important strategy would be to introduce non-added sulphite wines and transmit the right information of a healthier and more natural wine to the groups who associate sulphites as the cause of their malaise. Healthier and natural products are related very closely to the organic production which is a constantly a growing market in the wine industry (Goode and Harrop, 2011). Thus, it can produce significant competitive advantages for companies planning to differentiate their products in this market. Since consumers are still unaware of the difference between non-added sulphite and organic wines (Costanigro et al., 2014) and since the there is no scientific evidence of the difference between low sulphites and organic wines, companies may use the opportunity of the low sulphite wines production process which keep risk and production costs relatively lower than the organic production, taken advantage for differentiation and allow price premiums. However, producers should take into consideration the increased risk of faster oxidation and deterioration in comparison to regular wines.

Econometric results also confirm that several socio-demographic factors also exerted a positive and statistically significant effect on WTP for this type of wine. With respect to gender, Spanish women are prone to offer a premium price for a bottle of non-added sulphites wine in comparison to Spanish men. This is an expected result since in terms of alcohol preferences between genders, Spanish women show higher preferences for wine and beer than men (León-Muñoz et al., 2015). It is important to mention that this result is focused on the fact that Spanish women are willing to pay a premium price for higher quality wines with NAS in comparison to conventional wines, but is not a comparison of the wine consumption frequency among men and women. Focusing on higher quality food products this result is in line with Laroche et al. (2001) who found that the female segment of consumer is

more likely to pay premium prices for healthier and environmentally friendly food products in comparison to men. Comparing results with the Italian preferences across gender, we find the opposite effects. In other words, in Italy men are disposed to pay extra premium price for NAS wines in comparison to Italian women, in line with D'Amico et al. (2016). With respect to age, our findings suggest that younger Spanish consumers are willing to pay higher premium prices than the elderly people. This finding can be explained by the frequency of wine consumption at this age. As Garcia et al. (2013) reported, a vast majority of younger Spanish people consume wine only in special occasions and, as a consequence, they prefer to spend more money on high quality wines. In the same line, León-Muñoz et al. (2015) found that alcohol consumption among older adults in Spain is consistent with the traditional Mediterranean drinking pattern (moderate alcohol intake, mainly from wine and during meals), which decreases with age (MSSSI, 2011). Another important factor to mention is that in comparison to the Italian elderly people who are willing to pay premium prices for NAS wine, in Spain one of the most important attribute, beside price, is the origin and more specifically the protected designation of origin quality certification and organic (Brugarolas et al., 2005; De Magistris et al., 2014). Spanish elderly people might value the NAS type of wine as an additional production process as a result they do not give any additional value to it.

The "Wine Purchasing Frequency" exerted a positive and significant effect in both countries. Precisely, consumers who purchase more wine are more willing to pay a price premium for wines without sulphites. "Naturalness" variable can be reasonably considered as a proxy for the health attitude of consumers. This parameter was found to be a relevant factor in inducing consumers to pay a premium for NAS wine in both country (an increase of one rating on the scale augment WTP of 0,22€ in Spain and 0,11€ in Italy), and, moreover, it was one of the variable found significant that explained consumers' participation to the auction. This result is consistent with previous economics studies on organic food, if non-added sulphites wines are perceived so, confirming the positive effect of attitude toward naturalness on consumer choices thus influencing the intention to purchase organic food (Hsu and Chen, 2014; Onyango et al., 2007). Although the presence of consumers who are not willing to pay any premium price in both countries is small, more than 80% of the total sample are disposed to pay average extra premium prices of 1,17€ ± 0,76€ in Spain and 0,90€ ± 0,50€ in Italy. This is a promising result demonstrating the existence of a seemingly profitable market for this category of wine in both countries. In addition, results show that about 20% of Italian and Spanish consumers appear to recognize a premium price of at least 2€ for this particular category of wines. Even though the size of this group of consumer is small, ad hoc marketing campaigns can be built in order to allow them to enter the market. Therefore, from a practitioner's point of view, this implies the necessity of a market segmentation to identify the characteristics of this group with a high willingness to pay, as it has been highlighted in this study. However, there are several limitations inherent and worth mentioning. First and foremost, there might be social desirability issues as respondents often seek to accomplish researchers rather than reveal their true preferences. The final number of subjects involved in the experimental treatments was quite limited (120 per country), although this is an acceptable sample size in the literature, it would lend more credibility if we had a larger sample. A larger sample would have given a more precise definition of the socio-demographical differences (age and gender) among the two countries. Moreover, the specific characteristics of the auction protocol, the BDM methodology, the absence of monetary endowment, undoubtedly influenced respondents. In addition, this research should foster new studies in other European countries culturally distant from Italy and Spain in order to better categorize and analyse on how the "sulphite-in-wine" issue affects consumers, analyse and define the market share of this niche and most importantly define the psychographic variables that will efficiently segment the market to direct ad hoc promotion campaigns designed to elicit a price premium.

Conflict of interest

None declared.

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References

Becker, G., DeGroot, M., Marschak, J., 1964. Measuring utility by a single-response sequential method. Behav. Sci. 9, 226–232.
Bernard, J.C., Bernard, D.J., 2010. Comparing parts with the whole: Willingness to pay for pesticide-free, non-GM, and organic potatoes and sweet corn, J. Agr. Resour. Econ. 35 (3), 457–475.
Bohm, P., Lindén, J., Sonnegård, J., 1997. Eliciting reservation prices: becker-degroot-marschak mechanisms vs. markets. Econ. J. 107, 1079–1089.
Bregoli, I., Hingley, M., Del Chiappa, G., Sodano, V., 2016. Challenges in Italian wine routes: managing stakeholder networks. Qual. Mark. Res. J. 19 (2), 204–224.
Brugarolas, M., Martínez-Carrasco, L., Martínez, A., Rico, M., 2005. Determination of the surplus that consumers are willing to pay for an organic wine. Span. J. Agric. Res. 3 (1), 43–51.
Burgstahler, A.W., Robinson, M.A., 1997. Fluoride in California wines and raisins. Fluoride 30 (3), 142–146.
Chengchu, L., Ruiying, C., Yi-Cheng, S., 2006. Bactericidal effects of wine on vibrio parahaemolyticus in oysters. J. Food Prot. 69 (8), 1823–1828.
Combris, P., Bazoche, P., Giraud-Héraud, E., Issanchou, S., 2009. Food choices: what do we learn from combining sensory and economic experiments? Food Qual. Prefer. 20 (8), 550–557.
Corrigan, J.R., Rousu, M.C., 2006. Posted prices and bid affiliation: evidence from experimental auctions. Am. J. Agric. Econ. 88 (4), 1078–1090.
Costanigro, M., McFadden, D.T., Kroll, S., Nurse, G., 2011. An in-store valuation of local and organic apples: the role of social desirability. Agribusiness 27 (4), 465–477.
Costanigro, M., Appleby, C., Menke, S.D., 2014. The wine headache: consumer perceptions of sulfites and willingness to pay for non-sulfited wines. Food Qual. Prefer. 31, 81–89.

D'Amico, M., Di Vita, G., Monaco, L., 2016. Exploring environmental consciousness and consumer preferences for organic wines without sulfites. J. Clean. Prod. 120, 64–71. http://dx.doi.org/10.1016/j.jclepro.2016.02.014.

Del Giudice, T., La Barbera, F., Vecchio, R., Verneau, F., 2016. Anti-waste labeling and consumer willingness to pay. J. Int. Food Agribus. Mark. *28* (2), 149–163.

De Magistris, T., Del Giudice, T., Verneau, F., 2015. The effect of information on willingness to pay for canned tuna fish with different corporate social responsibility (CSR) certification: a pilot study. J. Consum. Aff. *49* (2), 457–471.

De Magistris, T., Gracia, A., Albisu, L.M., 2014. Wine consumers' preferences in Spain: an analysis using the best-worst scaling approach. Span. J. Agric. Res. 12 (3), 529–541.

East, R., Lomax, W., Willson, G., Harris, P., 1994. Decision making and habit in shopping times. Eur. J. Mark. 28 (4), 56–71.

Feldkamp, T.J., Schroeder, T.C., Lusk, J.L., 2005. Determining consumer valuation of differentiated beef steak quality attributes. J Muscle Foods 16 (1), 1–15.

Flynn, L.R., Goldsmith, R.E., 1999. A short, reliable measure of subjective knowledge. J. Bus. Res. 46 (1), 57–66.

Fotopoulos, C., Krystallis, A., Ness, M., 2003. Wine produced by organic grapes in Greece: using means-end chain analysis to reveal organic buyers' purchasing motives in comparison to the non-buyers. Food Qual. Prefer. 14, 549–566.

Gaiter, D.J., & Brecher, J., 2000. Why do I get headaches from wine? *Wall Street Journal*.

Garcia, T., Barrena, R., Grande, I., 2013. The wine consumption preferences of young people: a Spanish case study. Int. J. Wine Bus. Res. 25 (2), 94–107. http://dx.doi.org/10.1108/IJWBR-2012-0007.

Goode, J., Harrop, S., 2011. Authentic Wine: Toward Natural and Sustainable Winemaking. The Regents of the University of California, Berkeley, CA.

Grunert, K.G., 1993. Food-related Life Style: Development of a Cross-culturally Valid Instrument for Market Surveillance. MAPP, Århus, Denmark.

Hsu, C.L., Chen, M.C., 2014. Explaining consumer attitudes and purchase intentions toward organic food: contributions from regulatory fit and consumer characteristics. Food Qual. Prefer. 35, 6–13.

Hung, Y., Verbeke, W., 2017. Sensory attributes shaping consumers' willingness-to-pay for newly developed processed meat products with natural compounds and a reduced level of nitrite. Food Qual. Prefer.

Jacquemet, N., Joule, R.V., Luchini, S., Shogren, J.F., 2013. Preference elicitation under oath. J. Environ. Econ. Manag. 65 (1), 110–132.

Jarisch, R., Wantke, F., 1996. Wine and headache. Int. Arch. allergy Immunol. 110 (1), 7–12.

Krystallis, A., Grunert, K.G., de Barcellos, M.D., Perrea, T., Verbeke, W., 2012. Consumer attitudes towards sustainability aspects of food production: insights from three continents. J. Mark. Manag. 28 (3-4), 334–372.

Laganà, P., Avventuroso, E., Romano, G., Gioffré, M. E., Patanè, P., Parisi, S., Moscato, U. & Delia, S. (2017). Use and Overuse of Food Additives in Edible Products: Health Consequences for Consumers. In Chemistry and Hygiene of Food Additives (pp. 39-46). Springer International Publishing.

Laroche, M., Bergeron, J., Barbaro-Forleo, G., 2001. Targeting consumers who are willing to pay more for environmentally friendly products. J. Consum. Mark. 18 (6), 503–520.

León-Muñoz, L.M., Galán, I., Donado-Campos, J., Sánchez-Alonso, F., López-García, E., Valencia-Martín, J.L., Rodríguez-Artalejo, F., 2015. Patterns of alcohol consumption in the older population of Spain, 2008–2010. J. Acad. Nutr. Diet. 115 (2), 213–224.

Lester, M.R., 1995. Sulfite sensitivity: significance in human health. J. Am. Coll. Nutr. 14, 229–232.

Lusk, J.L., Alexander, C., Rousu, M.C., 2007. Designing experimental auctions for marketing research: the effect of values, distributions, and mechanisms on incentives for truthful bidding. Rev. Mark. Sci. 5, 1.

Lusk, J.L., House, L.O., Valli, C., Jaeger, S.R., Moore, M., Morrow, J.L., Traill, W.B., 2004. Effect of information about benefits of biotechnology on consumer acceptance of genetically modified food: evidence from experimental auctions in the United States, England, and France. Eur. Rev. Agric. Econ. 31 (2), 179–204.

Lusk, J.L., Shogren, J.F., 2007. Experimental Auctions: Methods and Applications in Economic and Marketing Research. Cambridge University Press, UK.

Machado, R.M.D., Toledo, M.C.F., Vicente, E., 2009. Sulfite content in some Brazilian wines: analytical determination and estimate of dietary exposure. Eur. Food Res. Technol. 229 (3), 383–389.

Mauskop, A., Sun-Edelstein, C., 2009. Food and supplements in the management of migraine headaches. Clin. J. Pain. 25 (5), 446–452.

McDaniel, C., Gates, R., 2001. Marketing Research Essentials, fifth edition South-Western College Publishing, Cincinnati, OH.

Millichap, J.G., Yee, M.M., 2003. The diet factor in pediatric and adolescent migraine. Pediatr. Neurol. 28 (1), 9–15.

Ministry of Health (MSSSI). National health Survey, 2011. Ministry of Health website. 〈http://www.msssi.gob.es/estadEstudios/estadisticas/encuestaNacional/encuesta2011.htm〉 (accessed 23.06.17).

Nayga Jr., R.M., Woodward, R., Aiew, W., 2006. Willingness to pay for reduced risk of foodborne illness: a non hypothetical field experiment. Can. J. Agric. Econ. 54 (4), 461–475.

Olsen, J., Thach, L., Hemphill, L., 2012. The impact of environmental protection and hedonistic values on organic wine purchases in the US. Int. J. Wine Bus. Res. 24 (1), 47–67.

Onyango, B.M., Hallman, W.K., Bellows, A.C., 2007. Purchasing organic food in US food systems. Br. Food J. 109, 399–411.

Pomarici, E., Vecchio, R., 2014. Millennial generation attitudes to sustainable wine: an exploratory study on Italian consumers. J. Clean. Prod. 66, 537–545.

Pomarici, E., Amato, M., Vecchio, R., 2015. Italian wine consumers interest for eco-friendly information on the back label. Calitatea *16* (S1), 40.

Reiser, B., Schechter, M., 2009. Incorporating zero values in the economic valuation of environmental program benefits. Environmetrics 10 (1), 87–101.

Remaud, H., Mueller, S., Chvyl, P., Lockshin, L., 2008. Do Australian Wine Consumers Value Organic Wine? Doctoral dissertation. AWBR Academy of Wine Business Research, University of Siena.

Robin, S., 2010. What are the causes of a wine headache? Livestrong.

Rosenzweig, T., Skalka, N., Rozenberg, K., Elyasiyan, U., Pinkus, A., Green, B., Stanevsky, M., Drori, E., 2017. Red wine and wine pomace reduced the development of insulin resistance and liver steatosis in HFD-fed mice. J. Funct. Food 34, 379–389.

Shi, L., House, L.A., Gao, Z., 2013. Impact of purchase intentions on full and partial bids in BDM auctions: Willingness-to-pay for organic and local blueberries. J. Agr. Econ. 64 (3), 707–718.

Sogari, G., Corbo, C., Macconi, M., Menozzi, D., Mora, C., 2015. Consumer attitude towards sustainable-labelled wine: an exploratory approach. Int. J. Wine Bus. Res. 27 (4), 312–328.

Thorne, F., Fox, J.A.S., Mullins, E., Wallace, M., 2017. Consumer willingness-to-pay for genetically modified potatoes in Ireland: an experimental auction approach. Agribusiness 33 (1), 43–55.

Vally, H., Thompson, P.J., 2001. Role of sulfite additives in wine induced asthma: single dose and cumulative dose studies. Thorax 56, 763–769.

Vecchio, R., Annunziata, A., 2015. Willingness-to-pay for sustainability-labelled chocolate: an experimental auction approach. J. Clean. Prod. 86, 335–342.

Vecchio, R., Decordi, G., Grésillon, L., Gugenberger, C., Mahéo, M., Jourjon, F., 2017. European consumers' perception of moderate wine consumption on health. Wine Econ. Policy.

Wertenbroch, K., Skiera, B., 2002. Measuring consumers' willingness to pay at the point of purchase. J. Mark. Res. 39 (2), 228 (–214).