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Research report

Consumers' reactions to nutrition and ingredient labelling for wine – A cross-country discrete choice experiment

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ABSTRACT

The purpose of this study is to examine consumers' reactions to the introduction of nutrition and ingredient labelling for wine, a product that is so far still exempt from mandatory nutrition and ingredient labelling. It also analyses the effect of positive and negative information about the use of ingredients in wine on consumers' choice. Representative samples for wine consumers from three distinctly different countries representing old and new wine markets (Australia, n = 745; Germany, n = 716; Italy, n = 715) completed a discrete choice experiment (DCE) with graphically simulated wine back labels. For each country, respondents were randomly allocated to a reference group and two different treatment conditions where they received newspaper-like information (positive, negative) before making choices. Results for the reference condition show that consumers across all three countries have a significant positive utility for detailed nutrition information. Instead, ingredient information only receives a positive utility in Italy, whereas German and Australian respondents do not receive utility from ingredient labelling. When consumers in the treatment group are confronted with negative media information the attribute importance of ingredients significantly increases across all three countries, clean labelled products without ingredients are preferred, and a significantly higher share of consumers in Germany and Italy prefer not to buy any wine. The treatment effect of positive media information on consumers' wine choice is lower than that of negative information. The results of the study have implications for the pending new regulation of wine labelling and for communication strategies of the wine industry that should actively inform consumers about the necessity of ingredients in wine production.

1. Introduction

Labelling on packaged goods ensures that consumers can make informed purchasing decisions (European Commission, 2017, p. 58). Therefore, the European Union's (EU) regulation on providing food information to consumers (Reg. 1169/2011) requires most pre-packaged foods to be labelled with both the key nutritional values and the list of ingredients. Excepting ingredients that may have allergenic effects, beverages above 1.2% alcohol by volume have been exempted from mandatory nutrition and ingredient labelling so far. However, in a 2017 report, the European Commission (EC) examined the possibility of abolishing this special regulation and concluded that such exemption could not be justified due to consumer protection (European Commission, 2017, p. 58). The EC have yet to react to the self-regulatory industry proposal submitted by the wine sector in March 2, 018.[1] However, regardless of the outcome of this proposal, industry experts expect that alcoholic beverages will be required to follow the current regulation for food labelling in the near future (Eales, 2020).

While this will affect all alcoholic beverages, the wine industry is of special interest. Consumers generally prove to have little knowledge

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[1] The wine sector committed to provide the energy levels and lists of ingredients for wines, either on- or off-label, using online devices, starting from March 2021.

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about the nutrition and ingredients of alcoholic beverages (Annunziata et al., 2016b; Grunert et al., 2018). They generally perceive wine as being a highly natural product and often assume it only includes grapes (Battaglene, 2014; Grunert et al., 2018). Previous research suggests that consumers will react negatively to being confronted with a possibly long list of ingredients on wine (Pabst, Szolnoki, & Loose, 2019). While the EC's decision will affect all wine-growing EU member states, as well as every country worldwide that exports wine to an EU member state, it is likely that similar regulations will follow in other countries, once the EU has made nutrition and ingredient labelling for wine mandatory (Waye, 2016).

A substantial body of research has investigated consumers' attitudes towards nutrition and ingredient labelling for food in general (Cowburn & Stockley, 2005; Drichoutis et al., 2005; Grunert et al., 2010; Grunert & Wills, 2007; Hersey et al., 2013; Miller & Cassady, 2015). The consequences of the mandatory ingredient and nutrition labelling of alcoholic beverages, and of wine specifically, have also been examined by a growing number of studies in recent years (Annunziata et al., 2016a, 2016b; Grunert et al., 2018), which illustrates the increasing awareness of this problem.

Most existing studies on wine directly assess consumers' interests and attitudes towards ingredient and nutrition information using scales (Annunziata et al., 2016a, 2016b; Bui et al., 2008; Grunert et al., 2018). However, attitudes have proven to be poor predictors of consumers' real food choices (Cardello, 2005; Garber et al., 2003; Martínez-Carrasco et al., 2015). Instead of asking consumers directly about their attitudes, discrete choice experiments (DCEs), have been found to generally offer higher external validity to measure consumers' real behaviours (Chang et al., 2009; Farsky et al., 2017; Louviere & Islam, 2008). Compared to preferences revealed through trade-offs in choice experiments, stated interest tends to strongly overestimate consumers' real information usage (Auger et al., 2003; Comşa & Postelnicu, 2013; Jacoby et al., 1977).

While Pabst, Szolnoki, & Loose, 2019 have used a qualitative and observatory approach to examine consumers' realistic behaviours and their spontaneous reactions when confronted with both ingredient and nutrition information on a bottle of wine, the study was only conducted among a few participants in Germany, and, thus, the results cannot be generalised. Existing findings require substantiation and cross-validation in multiple wine markets via quantitative research methods.

Therefore, this study aims to analyse consumers' reactions to mandatory ingredient and nutrition labelling for wine using a choice experiment across three major and distinct international wine markets.

2. Theoretical background and hypothesis

Consumers' relationships with nutritional and ingredient labelling on food has been extensively investigated (Grunert et al., 2018).

There are contradictory findings on consumer interest in nutritional information that depend on the type of food examined and the research method utilised (Annunziata et al., 2016a; Grunert et al., 2018; Pabst, Szolnoki, & Loose, 2019). Regarding interest in receiving nutritional information for wine, consumers in focus groups stated that they would be more interested in receiving information about the winery or sensory tasting notes, as they believe that nutrition information is unnecessary and adds no value to the product (Pabst, Szolnoki, & Loose, 2019). This is in line with studies in natural retail environments using indirect measures, such as eye-tracking or choices taken from shelves, which have revealed very low or insignificant effects of nutrition labelling on food product choices in general (Cecchini & Warin, 2016; Jacoby et al., 1977; Koenigstorfer et al., 2014; Wąsowicz-Kiryło & Styśko-Kunkowska, 2011). On the contrary, most studies focusing on consumers' stated interest in nutrition information for alcoholic beverages found that respondents are generally interested in receiving this information (Annunziata et al., 2016a; Grunert et al., 2018; Kypri et al., 2007; Thomson et al., 2012). This is confirmed by Annunziata et al. (2016b), who verified consumers' preference to receive nutritional information about wine using a conjoint analysis. While current research reveals differences, most studies focusing on wine suggest that consumers are interested in nutritional information. This leads to the first hypothesis (H1) of this study:

H1. Providing nutritional labelling information about wine increases purchase intent and results in a positive consumer utility.

In most studies using stated preferences, consumers have been shown to generally be interested in receiving information about the ingredients used for the production of alcoholic beverages (Annunziata et al., 2016a; Grunert et al., 2018; Kypri et al., 2007; Thomson et al., 2012). A first DCE among Australian wine consumers revealed that, at least for some consumers, ingredient information on the back labels of wines influenced wine choices (Mueller, Lockshin, et al., 2010). Other studies have also confirmed that consumers are interested in receiving ingredient information about wine, especially because they perceive wine to be a highly natural product with no ingredients other than grapes (Grunert et al., 2018; Pabst, Szolnoki, & Loose, 2019). It can, therefore, be assumed that this new-to-them information strongly impacts how consumers make wine choices. Accordingly, the second hypothesis (H2) of this study is:

H2. Providing ingredient labelling information about wine results in a positive consumer utility.

With the introduction of ingredient labelling for wine, it is likely that at least some media will write articles about the use of certain ingredients. Such articles, both negative and more informative, have already been published in print and online, even though there is generally low public awareness about wine ingredients. Research on the influence of media on food scares has shown that consumers strongly react to media coverage (Böcker & Hanf, 2000; Herrmann et al., 1997). Influence from articles on the topic will, therefore, likely result in consumers paying greater attention to ingredient lists on wine when making their choices. Hence, it can be hypothesised that:

H3a. Providing information about ingredients in wine significantly increases the utility of ingredient labelling.

Research also shows that consumers tend to react less strongly to positive than to negative media reports (Richards & Patterson, 1999; Smith et al., 1988). However, as long as information is more technical yet communicates potential benefits in a simple way, no strong negative effect of media coverage has been observed (Yamoah & Yawson, 2014). Accordingly, hypothesis H3b states:

H3b. Positive information has a significantly lower effect on the utility of wine ingredient lists than negative information.

According with Pabst, Szolnoki, & Loose, 2019, consumers in focus groups first reacted with shock and strong confusion when confronted with ingredient lists for wine because most perceive wine to be a highly natural product containing only grapes. After they had time to become accustomed to this information, most consumers stated that they would not stop buying wine because of ingredient labelling. The media potentially negatively dramatising the use of ingredients (other than grapes) in wine will strongly affect consumers' risk perceptions and attitudes (Bauer et al., 1996). Therefore, consumers' reactions to ingredient information for wine can be expected similar to consumers' reactions to media coverage about food scares (e.g., dropping sales until, eventually, sales begin to recover) (Böcker & Hanf, 2000). This leads to the following hypothesis:

H4a. Negative information significantly increases consumer rejection and their likelihood to buy any product. It increases the utility for the "No Buy" option.

Some consumers are likely to compare different ingredient lists to

look for the wine with the fewest ingredients (Pabst, Szolnoki, & Loose, 2019). This is in line with a general clean labelling trend, in which consumers actively seek products with few or only natural ingredients (Asioli et al., 2017). Accordingly, the next hypothesis asserts:

H4b. Negative information significantly increases utility for "no ingredient information".

3. Research methodology

3.1. Motivation for choice of countries

Grunert et al. (2018) found considerable differences between various European countries regarding their information preferences for nutrition and ingredient labelling. These differences go beyond what can be explained by cultural variation in response bias (Harzing, 2006). Therefore, to generate results with wider validity, the above hypotheses should be tested in wine markets that differ in respect to their key characteristics, such as winemaking history, consumption and buying patterns and the importance consumers place on different choice cues when purchasing wine.

"New World" wine countries tend to more strongly focus on innovation and technology in wine production (Aylward, 2003). "Old World", traditional wine markets, on the other hand, tend to focus on the narrative—that wine is a very much handcrafted product from small family-owned estates. It is of interest whether consumers from "New World" wine markets are more tolerant than consumers from traditional market toward using ingredients other than grapes in wine. For the study one "New World" and two "Old World" wine markets were selected (Campbell & Guibert, 2006; Hollebeek et al., 2007). It would have been desirable to include two "New World" countries into the study but budget restrictions did not allow this.

Australia is a typical "New World" wine country with a relatively young history of wine production and growing wine consumption. Regulation limits wine sales to licensed bottle shops. Mainly domestic wines are consumed, with grape variety being an important choice cue (Remaud & Couderc, 2006).

Italy is a traditional wine producing country of the "Old World" with strong domestic consumption where per capita consumption has been fallen strongly over the last decades (Corsi et al., 2014). Based on traditional "Romanic" regulation its regions are usually strongly linked to certain grape varieties and the wines produced in each region have strong, definitive sensory profiles (Campbell, Bernetti, Casini, & Marinelli, 2006).

While Germany has a long winemaking tradition and some domestic consumption, it is mostly known for being a very price-sensitive import market where grape variety is the most important choice cue after price (Szolnoki & Hoffmann, 2014). In addition, while Australia and Italy are mainly red wine producers, Germany is mostly known for producing white wines.

3.2. Motivation for choice experiment as purchase simulation

There are several ways to identify the importance consumers place on nutrition and ingredient information compared to other known choice cues, such as grape variety or price. Compared to asking consumers directly about their attitudes, methods that require respondents to make trade-offs have been found to generally exhibit higher external validity for consumers' real behaviour (Chang et al., 2009; Farsky et al., 2017; Mueller, Osidacz, et al., 2010; Russell et al., 2017). In a DCE, the respondents' attribute importance is derived indirectly by forcing the respondents to make trade-offs between different product concepts that consist of different levels of attributes (Louviere et al., 2000; Louviere & Islam, 2008; Williamson et al., 2016). Although DCEs are limited by hypothetical bias they have been extensively used in food consumer research (Blake et al., 2018; Russell et al., 2017; Scozzafava et al., 2016) and where shown to be highly predictive for real-world decisions across a wide range of choice contexts (Lancsar & Louviere, 2008; Lancsar & Swait, 2014).

3.3. Treatment conditions

To assess the effect of information on wine choices, the respondents of the choice experiment were randomly assigned to two different treatment conditions (Blake et al., 2018; Williamson et al., 2016). Prior to their choices, two groups of respondents received information about the use of ingredients in wine (see Fig. 1). The third group served as a reference and did not receive any information. Thus, the reference group represents the choice behaviour of wine drinkers without media influence.

Two short, newspaper-like articles were created to communicate different opinions about the use of ingredients other than grapes for wine production. While one article focused on the positive aspects different ingredients have for wine quality and shelf life, the second article focused on possible negative aspects. Each article consisted of a headline, an image and the main text. The authors created both articles by adapting existing international press articles. Respondents in the two treatment groups were directed to their respective article immediately before conducting the DCE. Respondents could only continue with their decisions after 30 s (measured by a 30-s timer) to encourage them to actually read the article.

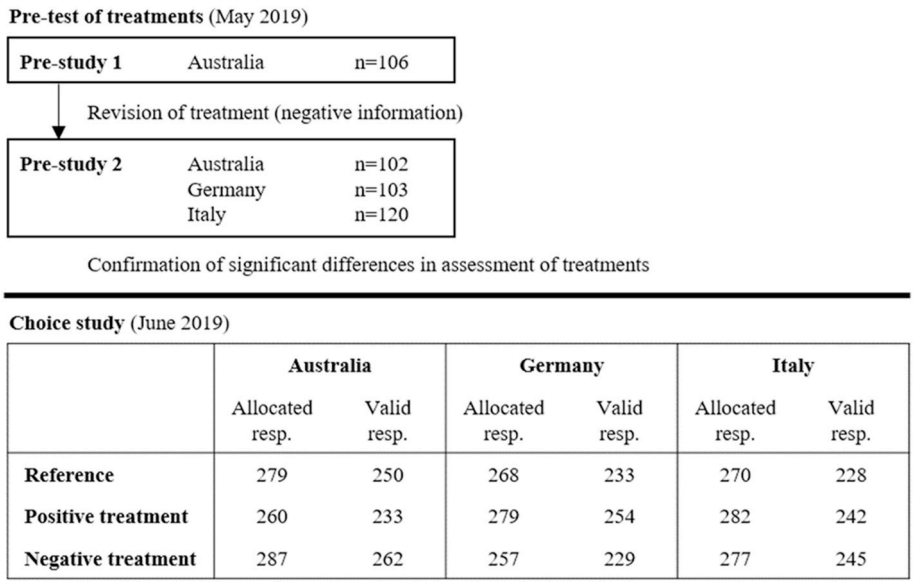
3.4. Pre-studies to validate and adjust treatment conditions

To ensure that the messages of the articles were perceived as intended, they were tested in two pre-studies (see Fig. 1). In Pre-Study 1, the articles were tested with 106 Australian consumers, who had drunk red wine in the past six months. For the pre-test, respondents read both articles in a randomised order. After reading each article, the respondents were asked to indicate their assessment on a 7-point scale, anchored from "1 = very negative" to "7 = very positive". Pre-Study 1 revealed that respondents' ratings of the two articles significantly differed, but the negative article was assessed as more neutral than negative, with an average score of 4.17 (Table 1). The wording, headline and photograph of the negative article were, therefore, adapted to cover aspects that were more negative. The positive article was not changed. Subsequently, in Pre-Study 2, the articles were tested with 102 Australian red wine drinkers, resulting in a stronger difference and a clear negative perception (2.7) of the negative article (Table 1). Both articles were then translated into German and Italian by native speakers and double-checked by a second set of native speakers. All translators had wine education backgrounds. The articles were tested with 103 (120) respondents in Germany (and Italy), who had drunk white (red) wine in the past six months. Respondents from all three sampled countries assessed the articles as intended (see Table 1). The assessment scale was also included in the main study and resulted in similar results.

The final versions of the articles are shown in Fig. 2.

3.5. Choice experiment

Choice sets were designed to display various back labels to respondents because nutrition and ingredient information is likely to appear on the back label of a wine bottle. A set of choice attributes, which are known to be relevant for wine (Lockshin et al., 2006; Loose & Remaud, 2013), were also included to assess the relative importance consumers place on nutrition and ingredient information compared to other attributes related to buying wine. For Australia and Germany, a total of six attributes were included in the DCE. For Italy, grape variety was not included because Italian wine quality classification regulations strictly prescribe grape varieties for origins without (mandatory) identification of the grape variety/ies on the label. Therefore, for Italy, only five attributes were included in the DCE. Each of these attributes



	Australia		Germany		Italy	
	Allocated resp.	Valid resp.	Allocated resp.	Valid resp.	Allocated resp.	Valid resp.
Reference	279	250	268	233	270	228
Positive treatment	260	233	279	254	282	242
Negative treatment	287	262	257	229	277	245

Fig. 1. Overview of pre-tests and respondent allocation to different treatments in choice experiment. Note: Valid respondents are those with complete data who did not speed through the survey (>9 min to complete).

Table 1
Average rating for assessment of treatments in Pre-Studies 1 and 2.

		Negative article	Positive article	Difference	p-value[a]
Pre-Study 1	Australia (n = 106)	4.17	5.26	1.09	<0.001
Pre-Study 2	Australia (n = 102)	2.70	4.89	2.19	<0.001
	Germany (n = 103)	2.94	4.88	1.94	<0.001
	Italy (n = 120)	3.20	4.75	1.55	<0.001

Note: Assessment of the article on a 7-point scale from "1 = very negative" to "7 = very positive".
[a] One sample *t*-test.

presents three to six levels, as shown below. Three levels were chosen for grape variety and region of origin to better reflect the strong variance available on the market and to avoid an underestimation of their effect size due an inappropriate choice design (Ryan & Wordsworth, 2000). Further details can be found in Table 2.

- Grape variety: Two well-known grape varieties, in addition to one not well-known variety, were selected as typical for wine production in Australia and Germany. Selection was based on reputation and relative market share.
- Region of origin: One well-known, one medium-known and one not well-known region of origin were selected from each country. Selection was based on reputation and relative market share.
- Price: Based on existing market research, the prices ranged from very low to very high. For Germany and Italy, prices ranged from €2.49 to €7.49, and, for Australia, prices ranged from $6.99 to $23.99.
- Additional information on the wine: Three levels were selected—no additional information, only sensory information, sensory information and food pairing recommendations.
- Nutrition information: Three attribute levels of nutrition information were selected—no nutrition information, a short nutrition table only showing the energy value of the wine and a long nutrition information label showing all the nutrition information that is mandatory for other foods (energy, fats, saturated fatty acids, carbohydrates, sugar, protein and salt). Winemakers and a nutritional value specialist checked the specific nutrition information to ensure realistic values.
- Ingredient information: Three levels were selected—only legally required information regarding sulphites, a short list of ingredients and a long list of ingredients. The selected additives were based on Resolution OIV-OENO 567A-2016, in which additives and processing aids are distinguished and defined. Winemakers in each country checked ingredient lists to ensure realistic specifications.

For all three countries, additional constant attributes were added because they are legally required and usually appear on a wine bottle's real back label. The country of origin and the wine quality indication were shown to comply with country-specific regulations. For Germany and Australia, fictitious lot numbers similar to typical lot numbers were selected. The information about the bottler was also indicated in a country-specific way. A standard bottle-size of 750 ml was chosen for all countries. Alcohol content was set at 14% volume for the red wines in Australia and Italy and at 12.5% volume for the white wines in Germany. A random barcode was shown to complete the back labels.

To combine the attribute levels into choice stimuli, an efficient design in 12 sets, each containing three alternatives, was developed using the software package Ngene by Choice-Metrics. The authors decided to opt for an efficient design to minimize the correlation in the data for estimation purposes, but also to generate data with a small as possible standard error (Choicemetrics, 2018). The priors for the attributes' levels chosen for the design come from a review of the literature and a consultation among the authors.

3.6. Choice stimuli visualisation

Choice stimuli were graphically designed in the same way for all three countries to represent realistic wine bottle back labels. Due to space limitations of standard computer screens, three back labels were

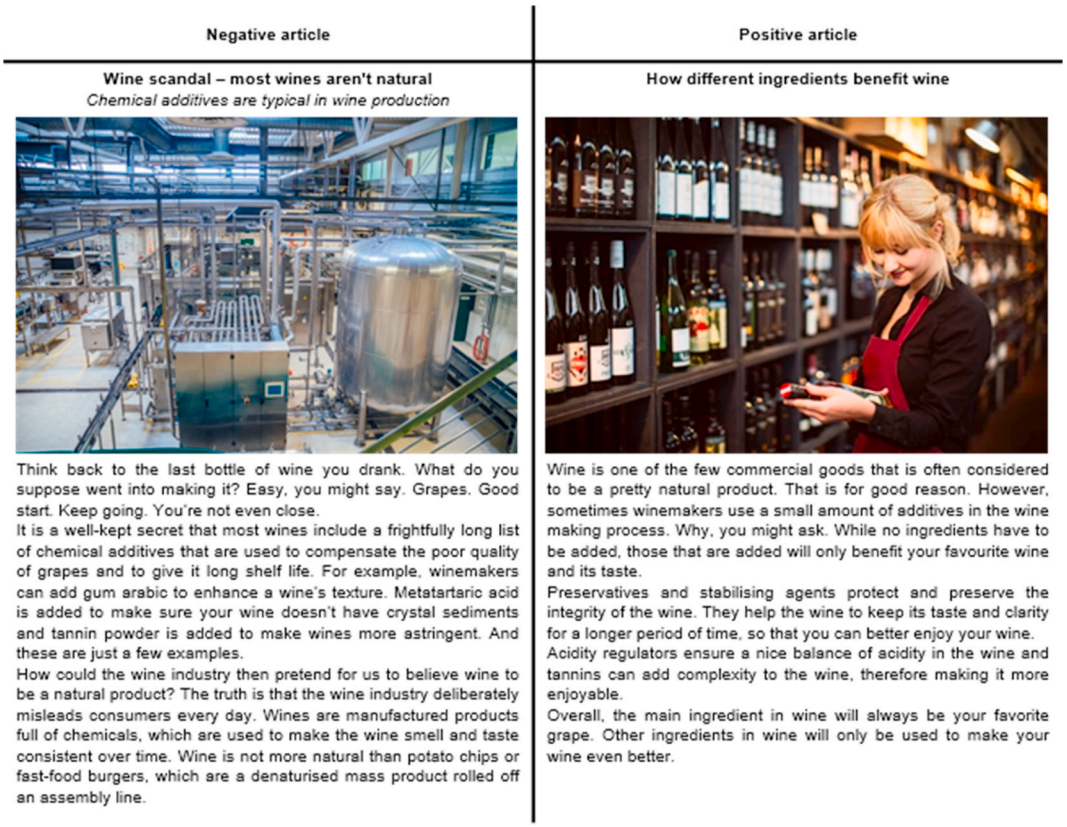


Fig. 2. Final articles versions for negative and positive treatment.

Table 2
Attributes and levels varied in the online choice experiment.

	Attribute	# Levels	Levels
Australia	Grape variety	3	Barbera, Shiraz, Cabernet Sauvignon
	Region of origin	3	Langhorne Creek, Coonawarra, Barossa Valley
	Price	6	$6.99, $9.99, $13.99, $16.99, $20.99, $23.99
	Additional information on wine	3	None, only sensory information, sensory information and food pairing recommendations
	Nutrition information	3	None, short nutrition table, long nutrition table
	Ingredient information	3	None, short ingredient list, long ingredient list
Germany	Grape variety	3	Müller-Thurgau, Grauburgunder, Riesling
	Region of origin	3	Nahe, Franken, Mosel
	Price	6	€2.49, €3.49, €4.49, €5.49, €6.49, €7.49
	Additional information on wine	3	None, only sensory information, sensory information and food pairing recommendations
	Nutrition information	3	None, short nutrition table, long nutrition table
	Ingredient information	3	None, short ingredient list, long ingredient list
Italy	Region of origin	3	Taurasi, Barbera d'Asti, Chianti
	Price	6	€2.49, €3.49, €4.49, €5.49, €6.49, €7.49
	Additional information on wine	3	None, only sensory information, sensory information and food pairing recommendations
	Nutrition information	3	None, short nutrition table, long nutrition table
	Ingredient information	3	None, short ingredient list, long ingredient list

shown next to each other in a choice set without a bottle. The length of the back labels was limited, so scrolling was not required to see a full label at once. Information was printed in a readable font size. Fig. 3 shows an example of a visualised choice set.

3.7. Choice instructions

Before being shown the first choice set, respondents received contextual information: "Now we would like you to imagine that you are in the store where you normally buy wine for an informal occasion at home or at a friend's home (e.g., dinner at home with friends, etc.). You are evaluating multiple wines, and you are happy with the way the front labels look. You have, therefore, decided to turn the bottles and choose a wine based on their back labels. We will show you 12 choice scenarios. Each scenario offers you three wine back labels from which to choose. Please tell us which ONE wine you would be most likely to purchase in each of the 12 choice scenarios." After the selection in each choice set was made, respondents were asked whether they would realistically purchase the wine chosen as the most preferred in the choice set. In case of negative answer, the choice was converted to a „None" option for the purpose of the analysis (Williamson et al., 2016).

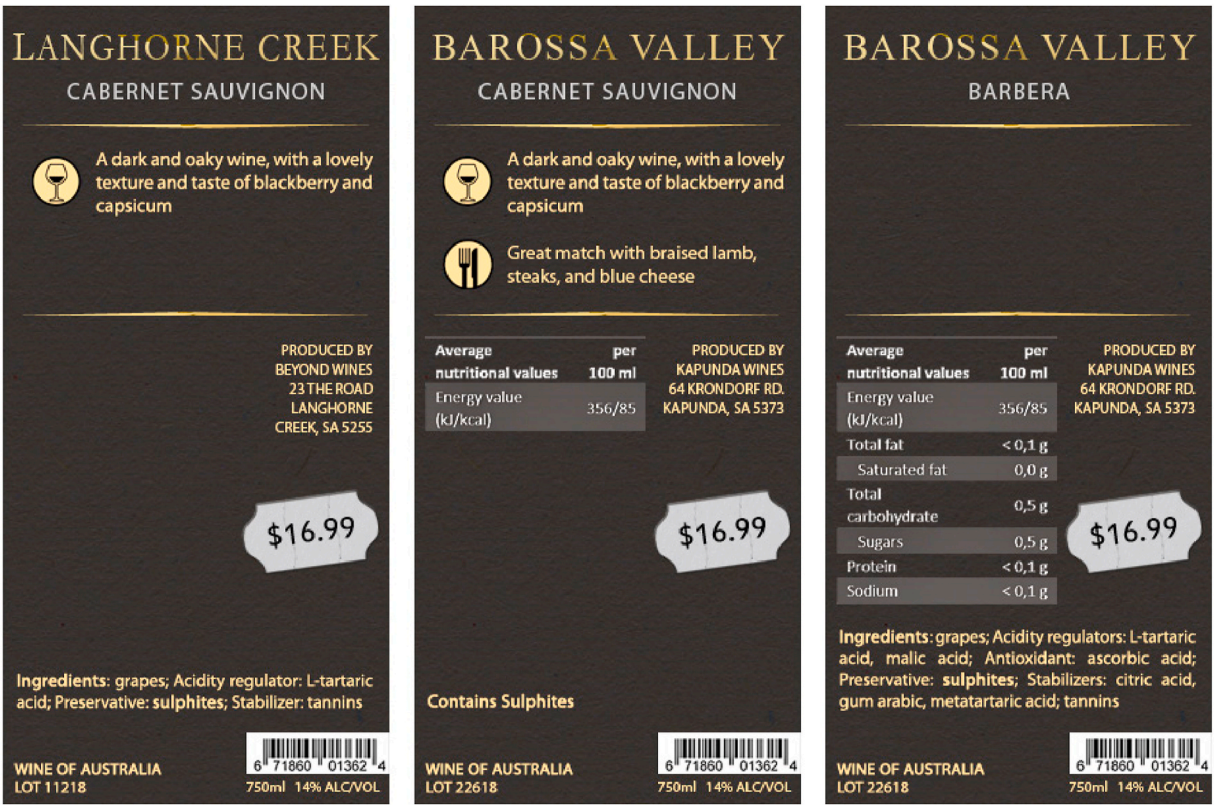


Fig. 3. Example of visualised choice alternatives (Australia).

Table 3
Sociodemographic information of respondents (%).

Australia			Germany			Italy		
	Resp. Sample n = 745	Regular wine drinkers[a]		Resp. Sample n = 716	Regular wine drinkers[b]		Resp. Sample n = 715	Regular wine drinkers[c]
Gender			*Gender*			*Gender*		
Male	51	50	Male	43	43	Male	48	48
Female	49	50	Female	57	57	Female	52	52
Age (in years)			*Age (in years)*			*Age (in years)*		
18–24	11	12	18–24	4	5	18–24	8	8
25–34	19	20	25–34	10	12	25–34	11	13
35–44	18	19	35–44	15	18	35–44	15	17
45–54	15	16	45–54	24	23	45–54	20	19
55–64	17	15	55–64	33	29	55–64	18	16
65+	20	18	65+	15	13	65+	28	27
Region			*Region*			*Region*		
New South Wales	30	31	Nordrhein-Westfalen	19	19	North	47	46
Victoria	27	28	Bayern	15	16	Central	19	20
Queensland	21	19	Baden-Württemberg	15	14	South	22	23
South Australia	11	10	Sachsen + Sachsen-Anhalt + Thüringen	13	12	Islands	12	11
Western Australia	8	8	Niedersachen + Bremen	9	10			
Tasmania	2	2	Hessen	8	7			
Australian Capital Territory	2	2	Rheinland-Pfalz + Saarland	7	7			
Northern Territory	0	0	Schleswig-Holstein + Hamburg	6	6			
			Mecklenburg-Vorpommern + Brandenburg	4	5			
			Berlin	4	4			

[a] Wine Intelligence (2016a).
[b] Wine Intelligence (2016b).
[c] ISTAT (2017).

3.8. Recruitment and sample description

Respondent sample criteria (age, gender and region) were based on representative samples of wine drinkers from each country, who drank red (white) wine at least once a month for Australia and Italy (Germany) (see Table 3). Respondents were also required to have bought wine in the off-trade within the past six months. A professional panel recruitment agency recruited respondents across all three countries using their internal recruiting platform. Respondents with incomplete data (those participants that did not finish the questionnaire) were eliminated. In addition, participants that needed less time than the fastest survey-tester when setting up the survey (under 9 min to complete) were also eliminated (Fig. 1).

The sociodemographic characteristics of the sample are congruent with the population of regular wine drinkers in all three countries (Table 3).

3.9. Statistical analysis

The LatentGOLD Choice 5.0 Syntax module was used for statistical analysis. To account for the panel nature of the data, scale-adjusted multinomial logit models with clustered standard errors by respondents were estimated accounting for error variance between the treatment conditions (Swait & Louviere, 1993). To test the impact of the attributes on consumer choice, the estimated part worth utilities u_i of the attributes and the corresponding Z-statistic were assessed. To descriptively compare the effect of attributes across the different countries, attribute importance was calculated based on likelihood-ratio tests (LR-tests) from the relative contribution of attributes to explained variance (Lancsar et al., 2007; Russell et al., 2017; Train, 2009). After testing for scale-invariance the treatment groups were compared to the reference condition in pair-wise multinomial logit models and the Wald (=) statistic indicates statistical difference.

4. Results and findings

Differences in error variances between the treatment conditions of each country were modelled by estimating a scale factor relative to the reference condition. Estimates resulted in scale factors not being statistically different from one (Table 4). This suggests that homogeneity of error variance can be assumed and that estimated part worth utilities can be directly compared across the treatment groups. For parsimony, scale factors were not included in the final models of which estimates are shown in Table 5, Table 6 and Table 7. Based on partial contribution to explained variance Table 8 shows the attribute importance for all three countries.

4.1. Utility of nutritional labelling in the reference condition

All three countries showed a similar pattern regarding the impact of nutritional information on wine choice in the reference condition (see Tables 5–7). Nutritional information significantly affected wine choice, and more information received a significantly higher utility than short or no information, implying that H1 is supported for all three countries. In the reference condition, nutritional information had similar relative attribute importance (see Table 8) in Australia and Germany (about 10%), but it was considerably more important in Italy (27%).

Table 4
Estimates for scale factors of error variance across treatment groups.

	Reference	Positive treatment		Negative treatment	
	Scale factor	Scale factor	z-Value	Scale factor	z-Value
Australia	1.000	1.002	0.324	0.981	0.324
Germany	1.000	1.011	0.312	1.073	0.311
Italy	1.000	0.996	0.326	0.988	0.325

4.2. Utility of ingredient labelling in the reference condition

In Australia and Germany (see Tables 5 and 6), the utility of ingredient information was not significantly different from zero in the reference condition. In Italy (see Table 7), consumers only had a significant positive utility for the short ingredient list and a marginally significant positive utility for the long ingredient list. The relative effect of ingredients on choice was low with an attribute importance of 4% (see Table 8). Therefore, H2 is only supported for Italy.

4.3. Impact of information on utility of ingredient labelling

Australia and Italy (see Tables 6 and 7) presented a similar pattern; the Wald (=) statistics did not show a significant difference between the positive treatment and the reference condition. In both countries, however, the negative treatment significantly increased the effect of ingredients compared to both the reference condition and the positive treatment. The utility of the long ingredient list increased to a significantly positive value. At the same time, the effect of sensory information significantly decreased. In Germany (see Table 5), both negative and positive treatments significantly increased the effect of ingredients and reduced the effect of sensory information. The utility of the long ingredient list significantly increased through both treatments.

The treatment effect of information was significantly lower for positive information (13% attribute importance of ingredients) compared to negative information (50% attribute importance), relative to 0% attribute importance in the reference condition (see Table 8). In Italy, the attribute importance of ingredient lists rose from 4% to 32% in the negative treatment, and, in Australia, it increased from less than 1%–16%.

These results imply that H3a can only be fully supported in Germany, where both positive and negative information treatments significantly increased the utility of ingredient lists. In Australia and Italy, this was true only for negative information. H3b, however, is supported for all three countries, as the positive article treatment resulted in a lower increase in utility compared to the negative article treatment.

4.4. Impact of negative information on utility of the "No Buy" option

The impact of negative information on the utility of the "No Buy" option was similar in Germany and Italy, where the negative article significantly increased the utility of the "No Buy" option compared to both the reference condition and the positive article (see Tables 6 and 7). In Australia, the negative article did not affect the utility of the "No Buy" option (see Table 5). H4a, therefore, is supported for Germany and Italy but not for Australia.

4.5. Impact of negative information on utility of "no ingredients information"

Regarding the impact of negative information, all three countries showed a similar pattern. The utility of "no ingredients" increased, as compared to both the reference and positive article conditions (see Tables 5–7). H4b, therefore, is supported for Australia, Germany and Italy. Overall results are summarised in Table 9.

5. Discussion and conclusion

5.1. Discussion

This study analysed the effects nutrition and ingredient labelling will have on consumers' wine choices. The results suggest that consumers strongly value transparency regarding nutritional information on wine in all three sampled countries. Nutrition information significantly impacted consumers' wine choices, and long nutrition information—including all nutritional data mandatory for other foods (energy,

Table 5
Utility estimates multinomial logit model, Australia.

		Reference			Positive Treatment			Negative Treatment			Pos. vs. Reference		Neg. vs. Reference		Pos. vs. Neg.	
		Utility	Z-Stat		Utility	Z-Stat		Utility	Z-Stat		Wald (=)	p-value	Wald (=)	p-value	Wald (=)	p-value
No Buy	No Buy	0.01	0.52		−0.02	−0.97		0.01	0.46		1.12	0.29	0.00	0.96	1.05	0.31
Variety	Barbera	−0.30	−7.97	**	−0.23	−5.96	**	−0.21	−5.72	**	2.71	0.26	3.96	0.14	3.20	0.20
	Shiraz	0.20	5.52	**	0.12	3.25	**	0.19	5.45	**						
	Cabernet Sauvignon	0.11	3.00	**	0.11	2.94	**	0.02	0.61							
Region	Langhorne	−0.02	−0.57		−0.03	−0.69		−0.04	−1.28		0.07	0.97	0.26	0.88	0.30	0.86
	Coonawarra	0.04	0.91		0.05	1.25		0.04	1.13							
	Barossa	−0.02	−0.46		−0.03	−0.70		0.00	0.00							
Nutrition information	None	−0.18	−5.48	**	−0.24	−6.87	**	−0.19	−5.61	**	2.12	0.35	3.47	0.18	2.47	0.29
	Short	0.01	0.22		0.01	0.26		−0.06	−1.93							
	Long	0.18	5.71	**	0.23	7.44	**	0.25	8.37	**						
Ingredient information	None	−0.03	−0.66		0.00	0.11		0.27	7.33	**	0.82	0.67	44.13	0.00	32.72	0.00
	Short	−0.03	−0.77		−0.02	−0.40		−0.03	−0.80							
	Long	0.06	1.62		0.01	0.33		−0.24	−6.74	**						
Sensory	None	−0.47	−12.39	**	−0.47	−11.94	**	−0.34	−9.71	**	0.90	0.64	6.69	0.04	7.30	0.03
	Short	0.04	1.26		0.00	0.06		−0.02	−0.62							
	Long	0.43	12.74	**	0.46	13.53	**	0.36	11.28	**						
Price	$6.99	0.40	4.27	**	0.43	4.45	**	0.55	5.90	**	2.74	0.74	2.65	0.75	1.86	0.87
	$9.99	0.47	5.83	**	0.41	4.88	**	0.36	4.54	**						
	$13.99	0.16	2.05	*	0.16	1.95		0.10	1.38							
	$16.99	−0.22	−2.25	*	−0.03	−0.28		−0.14	−1.45							
	$20.99	−0.32	−3.75	**	−0.35	−3.95	**	−0.35	−4.26	**						
	$23.99	−0.49	−5.56	**	−0.61	−6.71	**	−0.52	−6.09	**						

Adj. $R^2 = 0.06$; LL = −12,492.03; BIC(LL) = 25,314.73; n = 745, df = 695; Three treatment classes. * = significance level at $p < 0.05$; ** = significance level at $p < 0.01$.

Table 6
Utility estimates multinomial logit model, Germany.

		Reference			Positive Treatment			Negative Treatment			Pos. vs. Reference		Neg. vs. Reference		Pos. vs. Neg.	
		Utility	Z-Stat		Utility	Z-Stat		Utility	Z-Stat		Wald (=)	p-value	Wald (=)	p-value	Wald (=)	p-value
No Buy	No Buy	0.16	7.26	**	0.15	7.08	**	0.28	13.27	**	0.11	0.74	16.52	0.00	20.20	0.00
Variety	Müller-Thurgau	−0.13	−3.49	**	−0.13	−3.43	**	−0.12	−3.05	**	3.51	0.17	2.97	0.23	0.01	1.00
	Grauburgunder	−0.02	−0.50		0.06	1.71		0.06	1.45							
	Riesling	0.15	4.04	**	0.06	1.72		0.07	1.61							
Region	Nahe	−0.08	−2.16	*	−0.07	−1.88		−0.05	−1.16		0.97	0.62	1.43	0.49	0.18	0.92
	Franken	0.07	1.75		0.02	0.49		0.00	0.01							
	Mosel	0.01	0.21		0.05	1.35		0.05	1.17							
Nutrition information	None	−0.15	−4.19	**	−0.18	−5.31	**	−0.06	−1.73		0.88	0.64	2.96	0.23	5.68	0.06
	Short	−0.02	−0.62		0.02	0.69		−0.06	−1.50							
	Long	0.17	5.20	**	0.16	5.03	**	0.12	3.38	**						
Ingredient information	None	−0.02	−0.51		0.24	6.02	**	0.50	12.38	**	25.21	0.00	90.26	0.00	23.61	0.00
	Short	0.00	0.03		−0.05	−1.16		−0.15	−3.29	**						
	Long	0.02	0.56		−0.19	−5.22	**	−0.36	−8.55	**						
Sensory	None	−0.38	−9.59	**	−0.39	−10.54	**	−0.21	−5.54	**	0.08	0.96	17.31	0.00	18.69	0.00
	Short	−0.02	−0.57		−0.01	−0.19		0.01	0.26							
	Long	0.40	11.39	**	0.40	11.96	**	0.20	5.54	**						
Price	€2.49	0.32	3.42	**	0.21	2.38	*	0.21	2.26	*	5.63	0.34	2.69	0.75	0.88	0.97
	€3.49	0.54	6.54	**	0.37	4.62	**	0.43	4.96	**						
	€4.49	0.31	3.95	**	0.23	3.09	**	0.26	3.51	**						
	€5.00	−0.12	−1.22		−0.06	−0.66		−0.02	−0.21							
	€6.49	−0.36	−4.12	**	−0.28	−3.43	**	−0.34	−4.04	**						
	€7.49	−0.68	−7.90	**	−0.46	−5.44	**	−0.54	−6.13	**						

Adj. $R^2 = 0.05$; LL = −12,010.27; BIC(LL) = 24,349.23; n = 716; df = 666; Three treatment classes. * = significance level at $p < 0.05$; ** = significance level at $p < 0.01$.

Table 7
Utility estimates multinomial logit model, Italy.

		Reference			Positive Treatment			Negative Treatment			Pos. vs. Reference		Neg. vs. Reference		Pos. vs. Neg.	
		Utility	Z-Stat		Utility	Z-Stat		Utility	Z-Stat		Wald (=)	p-value	Wald (=)	p-value	Wald (=)	p-value
No Buy	No Buy	−0.15	−6.10	**	−0.28	−10.59	**	0.02	0.89		11.63	0.00	26.88	0.00	75.44	0.00
Region	Taurasi	−0.36	−9.53	**	−0.34	−9.47	**	−0.26	−7.38	**	0.49	0.78	3.30	0.19	2.80	0.25
	Barbera d'Asti	0.05	1.40		0.02	0.46		0.01	0.19							
	Chianti	0.30	9.60	**	0.32	10.66	**	0.26	8.13	**						
Nutrition information	None	−0.22	−6.37	**	−0.22	−6.70	**	−0.28	−7.87	**	1.73	0.42	1.35	0.51	4.36	0.11
	Short	−0.08	−2.43	*	−0.03	−1.04		−0.07	−2.04	*						
	Long	0.30	9.72	**	0.25	8.53	**	0.35	10.97	**						
Ingredient information	None	−0.08	−2.27	*	−0.04	−1.34		0.31	10.03	**	0.55	0.76	72.02	0.00	64.20	0.00
	Short	0.13	3.96	**	0.12	3.70	**	−0.03	−0.73							
	Long	−0.06	−1.61		−0.08	−2.28	*	−0.29	−7.84	**						
Sensory	None	−0.28	−7.05	**	−0.22	−5.80	**	−0.08	−2.20	*	2.17	0.34	22.95	0.00	11.68	0.00
	Short	−0.05	−1.42		−0.05	−1.44		−0.03	−0.79							
	Long	0.33	9.48	**	0.26	7.95	**	0.11	3.16	**						
Price	€2.49	−0.34	−3.27	**	−0.23	−2.06	*	−0.18	−1.86		1.21	0.94	3.18	0.67	1.79	0.88
	€3.49	0.23	1.89		0.16	1.27		0.13	1.27							
	€4.49	0.25	2.93	**	0.24	2.88	**	0.16	2.15	*						
	€5.00	0.10	1.37		0.12	1.67		0.16	2.48	*						
	€6.49	−0.04	−0.45		−0.01	−0.09		−0.06	−0.82							
	€7.49	−0.19	−2.12	*	−0.28	−3.16	**	−0.22	−2.70	**						

Adj. $R^2 = 0.06$; LL = −11,967.95; BIC(LL) = 24,177.09; n = 715; df = 671; Three treatment classes. * = significance level at $p < 0.05$; ** = significance level at $p < 0.01$.

Table 8
Attribute importance in Australia, Germany and Italy in percentages.

	Australia			Germany			Italy		
	Reference	Positive Article	Negative Article	Reference	Positive Article	Negative Article	Reference	Positive Article	Negative Article
Sensory information	53[a]	55[a]	37[b]	48[a]	54[a]	14[b]	26[a]	20[a]	3[b]
Price	19	19	19	34	17	23	6	6	5
Nutritional information	11	17	17	10	11	4	27	25	36
Ingredient information	0.7[b]	0.0[b]	16[a]	0.1[b]	13[a,b]	55[a]	4[b]	4[b]	32[a]
Variety	17	9	10	6	4	3			
Region	0.2	0.4	0.5	2	1.2	0.6	36	45	25

Note: Based on partial contribution of an attribute to explained variance (LR-test). Different superscripts indicate information conditions with significantly different Wald (=) Statistics for attributes (see Tables 5–7).

Table 9
Summary of supported hypotheses.

Hypothesis		Australia	Germany	Italy
H1	Providing nutritional labelling information about wine increases purchase intent and results in a positive consumer utility.	x	x	x
H2	Providing ingredient labelling information about wine results in a positive consumer utility.			x
H3a	Providing information about ingredients in wine significantly increases the utility of ingredient labelling.	(x)	x	(x)
H3b	Positive information has a significantly lower effect on the utility of wine ingredient lists than negative information.	x	x	x
H4a	Negative information significantly increases consumer rejection and their likelihood to buy any product. It increases the utility for the "No Buy" option.		x	x
H4b	Negative information significantly increases utility for "no ingredient information".	x	x	x

Note: x = hypothesis is supported; (x) = hypothesis is partly supported.

fats, saturated fatty acids, carbohydrates, sugar, protein and salt)—was most valued by consumers. While the study does not include all attributes that could potentially be found on wine labels (e.g., brand), it includes most of the attributes that commonly appear on the back labels of wine bottles.

The research indicates the high share of attribute importance consumers would place on nutritional information when choosing wines if this information was introduced for wine. In Italy, quality designation (i.e. region) was the most important back label attribute for consumers, as it is usually strongly linked with a certain reputation and a distinctive sensory profile; it was directly followed in importance by nutritional information about the wine. The distinct sensory profiles of the country's regions (Campbell, Bernetti, Casini, & Marinelli, 2006) might also explain the lower importance of sensory descriptions in Italy compared to Australia and Germany. Although considerably lower, nutritional information also had a high attribute importance of about 10% in Australia and Germany, especially compared to the attribute importance they placed on other common back label attributes, such as region in both countries (<3%) and grape variety in Germany (6%). In Australia and Germany, sensory descriptions played a dominant role in how consumers chose wines, followed by price. Even though consumers highly valued sensory information, this information is likely to be shortened or eliminated if nutrition and ingredient labelling is introduced, as competition for space on back labels would increase (Battaglene, 2014; Mueller, Lockshin, et al., 2010).

On the contrary, consumers paid little to almost no attention to ingredient lists on wine bottles if they were not actively confronted, either positively or negatively, with the use of ingredients (other than grapes) in wine. The study has shown that ingredient information only had a significant impact on how consumers chose wine in Italy, as they preferred short ingredient lists. However, the overall attribute importance consumers placed on ingredient lists when choosing wines was very low in all three countries. In Italy, consumers only placed 4% of their attribute importance on ingredients; in Australia and Germany, they placed <1%. This implies that, if ingredient information is introduced without any significant media coverage, consumers would not pay much attention to it, and it would have only minor influences on the wine industry. Only in Italy would producers be advised to work with shorter, rather than longer, ingredient lists.

This study provided first indications about the strong effects that negative media coverage can have on how consumers react to the use of ingredients, other than grapes, in wine as a driver for changing choice. With negative media coverage, consumers are very likely to place significantly more attention on ingredient information, and the role of sensory descriptions is expected to significantly decrease. While the pattern was similar in all three countries, the effect was strongest in Germany, followed by Italy, and was considerably lower in Australia. While the data does not give any indications why such differences existed between the countries, prior research has shown that New World countries, such as Australia, are more accustomed to the use of technology in wine production (Aylward, 2003) compared to traditional winemaking countries, such as Italy or Germany. This might also influence how consumers in those countries perceived the use of other ingredients in wine, while consumers in traditional wine countries often still thought of wine as a handmade product.

Nevertheless, in all three countries, consumers preferred to have no ingredients, or only a short ingredient list, for wine, when given the choice, after being confronted with negative information about the use of other ingredients in wine. This corresponds well to the general "clean labelling" trend, which has been taking place in recent years (Asioli et al., 2017). In addition, in Germany and Italy, our results suggest that some consumers would rather not buy any wine after being confronted with negative information about the use of other ingredients in wine. While this study did not cover the long-term effect of consumers receiving negative information, research on consumer reactions to food scares that received a significant amount of negative media coverage has shown that consumers' buying behaviours will, probably, eventually recover (Böcker & Hanf, 2000). This is likely also to be the case for the wine industry, especially because, compared to other food scares, using ingredients other than grapes in wine is not harmful to consumers. Nevertheless, the findings of this study suggest that the wine industry should consider to introduce consumers to the use of other ingredients in wine in a positive, informative way that might help to minimize the possible negative effects of media coverage.

Findings also indicate that consumers from New World wine markets reacted differently to nutritional and ingredient labelling for wine than consumers from more traditional wine markets. In both Germany and

Italy, consumers reacted strongly towards nutrition labelling and, in the context of negative media coverage, towards ingredient labelling. Australian consumers, on the other hand, generally reacted less strongly towards ingredient labelling. While the attribute importance of ingredient information significantly increased with negative media coverage, this rise in Australia was considerably lower than in Germany and Italy. Differently from traditional wine markets, Australian consumers indicated that they would also not opt-out of buying any of the wines when negative media coverage was introduced. While traditional wine markets tend to focus on communicating winemaking as a very handcrafted process with minimal use of technology, New World wine countries tend to be more open to innovation and technology in winemaking (Aylward, 2003). It is, therefore, not very surprising that consumers from traditional wine markets reacted more strongly towards the use of ingredients other than grapes in wine (especially in a negative context) than consumers from New World wine markets. In sum, therefore, the results show strong implications for the pending EU regulation of wine labelling and for communication strategies within the wine industry.

5.2. Limitations

This study does present some limitations. First, participants were forced to make their decisions solely based on the back labels of wine bottles. They were not confronted with bottle design, nor did they see front label information (as brand and vintage). Therefore, the wine choice did not completely mimic a real purchasing situation. In addition, some consumers generally do not look at back labels when choosing a bottle of wine. Therefore, the effect of nutrition and ingredient labelling may possibly be overestimated in this study due to limitations in the experimental design. However, it is likely that consumers will pay more attention to back labels, where nutrition and ingredient information will be displayed, after being informed about the topic through the media. Additionally, the study did not cover how consumers' reactions to nutrition and ingredient labelling on wine will adapt over time. Particularly, it did not assess if, and how, the effect of positive and negative media coverage could change after consumers became accustomed to the information. Lastly, this study is limited to aggregated effects across countries and consumer heterogeneity within countries (i.e. segments were not yet taken into account). Future research should analyse how consumers differ in how strongly they value nutrition and ingredient information for wine.

6. Conclusion

This study shows that nutrition and ingredient labelling on wine will significantly affect how consumers make wine choices. Consumers in all tested countries valued receiving detailed nutrition information on wine. In the likely event of negative media coverage about using ingredients other than grapes in wine, consumers will pay high attention to ingredient lists on wine, at least for a short period. Shorter ingredients lists, or clean-labelled wines without listed ingredients, will be preferred. Some consumers are likely to refrain from buying wine when they have been exposed to negative media coverage. While there were some differences in how consumers in the tested countries reacted to nutrition and ingredient labelling, the main conclusions of this study are valid across all three countries. In addition, as Australia, Germany and Italy were selected to represent a wide, diverse range of important wine consumption markets, the results showed a degree of generalisability, which has to be confirmed by future studies in further countries.

Declaration of competing interest

The authors declare no conflict of interest.

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