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Wine in a can: A consumer study in a traditional wine-producing region. Effect of the level of consumer involvement

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ABSTRACT

It is imperative that the wine industry embraces innovation, given the sector's traditionally conservative nature. To succeed, innovators must address consumer expectations, which are pivotal in shaping preferences and perceptions of quality. The present study investigated the effect of consumer involvement on wine perception, using packaging innovation as a starting point. One hundred and twenty-five non-professional wine consumers from the traditional Rioja wine-producing region in Spain took part in a tasting of two wines (one red and one white) under two different conditions. Participants were informed that under one experimental condition, the wine was bottled, whereas in the other the wine was canned. The samples were drawn from the same bottle to ensure only the provided information was modified, without altering the intrinsic properties, thus allowing a focus on consumers' cognitive responses. The two containers, a 200 mL can and a 125 mL bottle, were designed with the same label and packaging colour. The participants were first asked to evaluate each sample's quality and liking on a 10-point scale. They described each sample using the Rate-All-That-Apply (RATA) methodology. The participants then completed a validated questionnaire designed to measure their level of involvement with wine, which was used to segment consumers into four groups. Finally, the participants were asked to provide demographic information. The results of the study confirm that in the case of red wine, the more innovative packaging, the aluminium can, has a negative impact on the perceived quality of the product. This remains consistent regardless of the level of involvement, wine colour, or the preference for red wine. Conversely, in the case of white wine, no effect of the packaging was observed on consumer's liking except for highly involved consumers. This suggests that canned young white wine could be a suitable alternative for traditional consumers. Furthermore, the "canned" wines, though they were never in actual contact with the aluminium packaging, were perceived as more metallic and less fruity, regardless of the wine. The results are discussed in terms of cognitive mechanisms influencing wine perception, including the desire for unique products (DFUP), the concept of "image mold" and consumer expectations.

KEYWORDS: top-down, image mold, innovative packaging, consumer involvement

INTRODUCTION

The use of cans for wine packaging offers a number of environmental advantages over glass bottles. The first is the recyclability of cans, which is significantly higher than that of glass bottles. The Aluminium Association reported that the average recycled content of an aluminium can is 71 %, while the recycled content of a glass bottle is around 23 % (The Aluminium Association, 2024). Secondly, cans are more cost-effective to produce due to the high energy demands of glass production, which requires temperatures between 1,400 and 1,600 °C for melting. Thirdly, the environmental footprint is significantly lower due to the lighter weight of aluminium cans compared to glass bottles (Ponstein, *et al.*, 2019). Another potential advantage of using cans is that they protect wine against light, which can induce significant sensory changes, particularly in terms of colour and aroma. It is reported that colour is altered due to the photodegradation of iron (III) tartrate, yielding glyoxylic acid (Grant-Preece *et al.*, 2017). This aldehyde then reacts with flavan-3-ols to form yellow xanthylium cation pigments. Furthermore, the photochemical formation of sulphur-like aromas (linked to the production of methanethiol and dimethyl disulphide) may negatively impact wine aroma (Grant-Preece *et al.*, 2017). In addition to the environmental and conservation benefits, this type of container is both lighter and more robust, allowing wine to be consumed in a variety of environments, including outdoors, and reducing the risk of breakage during transport (Weed, 2019). Moreover, the external aluminium surface can be screen printed with any image and colour, which is not possible with glass containers (Merlino *et al.*, 2020). This opens up the potential for innovative designs, providing a significant competitive advantage and allowing access to different segments of the wine consumer market (Ellicott & Roncarelli, 2010).

Despite the benefits, particularly environmental ones, associated with aluminium cans as wine packaging, consumer acceptance is still relatively low. This is mainly due to the perception that wine in aluminium cans is of lower quality than wine in bottles (Lefebvre & Orłowski, 2019; Orłowski *et al.*, 2022; Ruggeri *et al.*, 2022). This prejudice against can packaging is related to the concept of “image mold” first introduced by Cheskin (1957) to describe the phenomenon whereby specific formats or packaging shapes are associated with particular products. The concept of “image mold” may be understood as a cognitive schema, that is to say, a mental structure that facilitates the organisation and interpretation of information and gives shape to perceptual images. Consequently, when a modification is made to packaging that has consistently been presented in the same format and thus has a pre-established “image mold”; it has a psychological impact on how consumers perceive the product itself (Orłowski *et al.*, 2022). The discrepancy between the packaging and the expectations it creates results in a loss of appeal for the product (Orłowski *et al.*, 2022). In other words, when the concept of a quality wine is evoked, the image of a 750-mL glass bottle is automatically conjured.

Traditional 750-mL glass bottles remain a preferred choice, particularly among traditional high-involved wine consumers (Ruggeri *et al.*, 2022). The primary obstacle to the acceptance of alternative wine packaging is a lack of awareness and familiarity with the format, which leads to perceptions of incongruity and incompatibility between quality wine and aluminium cans (Ruggeri *et al.*, 2022). Notwithstanding, demand for alternative wine packaging designs has notably increased in recent years. In less than a decade, the value of canned wine sales in the United States grew from \$2 million in 2012 to over \$183.6 million in 2020 (Weed, 2020). The placement of canned products in a variety of venues has made wine more accessible and appealing to a wider audience. Wine is often associated with formal occasions, but canned wine has changed this perception by allowing people to taste wine in more casual settings such as at sporting events, picnics, and barbecues (Weed, 2019; Williams, 2019).

Wine consumption provokes a multisensory experience, which can be attributed to both intrinsic and extrinsic dimensions (Charters & Pettigrew, 2007) as well as the consumption context (Dacremont & Sester, 2019). Extrinsic wine cues, such as wine packaging, provide information to consumers which influence their expectations of the product (Piqueras-Fiszman & Spence, 2012). These expectations have been shown to influence the appreciation of a red wine blend, as measured by a wine-liking scale ranging from “very bad” to “very good.” As part of a pre-test, this comparison between the traditional 750-mL bottle and an aluminium can was conducted with 61 customers in the U.S. The findings revealed that canned wine was perceived to possess a less favourable taste profile compared to wine in a traditional 750-mL glass bottle (Orłowski *et al.*, 2022). This effect was explained as resulting from cross-modal correspondences between visual and flavour stimuli (Lefebvre & Orłowski, 2019).

The interpretation of wine dimensions with respect to perceived quality and liking varies among consumers due to various factors, of which level of involvement has often been highlighted (Aurifeille *et al.*, 2002; Bruwer & Buller, 2012; Cox, 2009; Hollebeek *et al.*, 2007; Lockshin *et al.*, 2001; Parr *et al.*, 2011; Sáenz-Navajas *et al.*, 2015; Torri *et al.*, 2013). Highly involved wine consumers were shown to rely more on their own knowledge and experience when selecting wines, while less involved consumers are more influenced by external opinions (Koksal, 2021). Low-involvement consumers are more likely to consider innovative wine packaging (Ferrara *et al.*, 2020; Nesselhauf *et al.*, 2017) and occasional, or non-regular, wine consumers (Ruggeri *et al.*, 2022) are willing to re-evaluate purchasing such products when assured that alternative packaging preserves quality and could contribute to greater sustainability (Ferrara *et al.*, 2020).

Nevertheless, due to the high level of competition in this sector at a global level, the wine industry is in great need of innovation. This raises the question of how consumers respond to innovations in this field. While previous studies have concentrated on the acceptance of canned wine, to the best of our knowledge, the effect of wine container (can vs glass bottle) on perceived flavour nuances has not previously been addressed.

The objective of this study was to understand and generate knowledge about how consumers from a traditional wine-producing region (*i.e.*, Rioja in Spain) perceive wines in alternative packaging as a function of their involvement. Furthermore, the relationship between perceived quality, consumer liking and sensory characterisation as a function of both wine type (red and white wine) and consumer involvement in a traditional market was investigated. In this context, our hypotheses were the following:

H1) The consumers in this study were from a traditional wine-producing region (D.O.Ca. Rioja), where the commercialisation of wine in glass bottles is mandatory. This results in forming expectations, thereby establishing a “mold image” of what constitutes a quality wine. Consequently, it was hypothesised that a wine would receive lower quality and liking scores if it is in a can than if it is in a bottle.

H2) Perceptions of wine quality and liking differ depending on packaging (bottle *versus* can) and vary according to the consumer’s level of wine involvement. Based on previous studies we expect highly involved participants to be more influenced by packaging than other participants.

H3) Based on expectations, significant differences are expected in the perception of wine flavour (aroma, taste, and tactile sensations) depending on packaging and the consumer’s level of involvement.

MATERIALS AND METHODS

1. Participants

Participants were recruited on the basis of their interest through public in Logroño (capital city of La Rioja) and social media. Candidates were required to meet the following inclusion criteria: (1) to consume wine at least once a month, (2) to have lived minimum 10 years in the La Rioja region or the D.O.Ca. Rioja area, (3) to be of legal age, and (4) must not be an expert or be professionally affiliated to the wine sector (winemakers/vintners/wine professionals/oenology students).

A total of 125 consumers participated in the study, with a balanced distribution across age ranges and genders (Table 1).

TABLE 1. Distribution of the 125 participants according to age and gender.

Age (years)	%
< 20	11 %
20–29	22 %
30–39	21 %
40–49	24 %
> 60	23 %
Gender	
Males	51 %
Females	49 %

2. Wines

Two wines – one white (100 % Viura) and one red (100 % Tempranillo) – in their first year of ageing, without wood contact, were presented to the participants under two conditions: can or bottle. Young wines were selected to avoid confounding variables such as the potential ageing capacity of the containers. The two wines were produced at the Rioja Government’s Institutional Winery, Finca La Grajera (D.O.Ca. Rioja). The wines were gently donated by the La Rioja Government.

3. Experimental conditions

The tests were conducted in the sensory analysis laboratory of the Faculty of Science and Technology, Universidad de La Rioja. Participants each attended one 30-min session, conducted on a flexible schedule (10 am–6 pm) from February to March 2022. Maximum 10 consumers participated at a time. The environmental parameters were set in accordance with the UNE-EN ISO 8589:2010/A1:2014 standard for optimal sensory evaluation: 20 °C ambient temperature, absence of odours (due to the negative air-flow ventilation system), soundproofing from external noise, ambient lighting of colour temperature (5,000 °K to 7,000 °K), and neutral colours. During the evaluation participants were requested to use the spittoons.

4. Procedure

Participants entered the room and were each assigned a designated evaluation booth. They were presented with the consent and information forms, and the response sheet (S1 of the supplementary data). The session proceeded in three main stages: 1) socio-demographic questionnaire, 2) tasting of the four wine samples with evaluation of perceived quality, liking, and description (RATA), and 3) involvement questionnaire.

Stage 1. Participants were first asked to complete a questionnaire that included socio-demographic information (age range, gender, and level of education), as well as information on their professional connection to the wine sector, their region of residence for the last 10 years, and their frequency of wine consumption.

Stage 2. Upon completion of the questionnaire, all participants received four wine glasses (two red and two white), monadically presented, which had previously been poured. The order of presentation varied for each participant according to a William Latin square. The two red or white samples were served from the same bottle, which assured the same intrinsic properties of wines in each category. This ensured that the wines were identical, differing only in the fictitious container label from which each was said to originate (bottle or can). To further induce consumers to imagine that samples came from different containers, either a 125 mL glass bottle (bottle condition) or a 200 mL can (can condition) was positioned in front of the corresponding glass. Each glass was set at a distance sufficient to prevent contact with the container, thus assuring haptic properties of the container did not influence the evaluation. The containers were provided to prompt participants to imagine the wine was packaged in a bottle or a can, despite this not actually being the case. The container formats were selected because they are already commercially available in comparable volumes. This was to avoid potential effects of container size on perception, assuming that the 750 mL bottle is the traditional format compared to the miniature version selected. The tasting samples were served in transparent glasses (UNE-EN ISO 87022:1992 standard) each containing 20 mL of wine and covered with a petri dish to prevent the loss of volatile aromatic compounds. A coded identifier consisting of three randomly selected digits was placed on each glass, as well as a label indicating the container type (can or bottle). The task consisted of two parts. First, participants rated wine quality (0 = insufficient, 2 = fair, 4 = acceptable, 5 = good, 8 = very good, 10 = excellent) and liking (0 = not at all liked, 2 = not liked, 5 = neither liked nor disliked; 7 = liked, 10 = very much liked) on 10-point structured scales. The correlation between perceived quality and liking of wines has been demonstrated to be consistent among wine experts; however, these constructs may vary among non-professional, regular wine consumers (Hopfer & Heyman, 2014). The present study was concerned with evaluating this possibility and therefore both attributes were measured.

Second, the participants described each sample using the Rate-All-That-Apply (RATA) method. They were provided a list of attributes and instructed to select those they perceived in the sample, rating intensity of each on a 7-point scale. Twenty-six attributes were identified based on the literature (Coulon-Leroy *et al.*, 2017; Danner *et al.*, 2017; Mahieu *et al.*, 2020), including 17 aromas (Table 2), 3 tastes (bitter, sour, sweet), 5 tactile sensations (drying/astringent, watery, burning, metallic, light), and 1 global attribute (balance). Attributes were randomised for each participant using *PineTools* online tool (<https://pinetools.com>) to avoid any influence from attribute presentation order.

Stage 3. The final part of the protocol was dedicated to assessing participants' involvement with the world of wine by measuring their habits and opinions. A scale of 23 items

was employed (Table 3), corresponding to five dimensions of involvement: interest, behaviour, ritual, pleasure, and risk (Bruwer & Buller, 2013). Seven of the 23 items were presented in reverse order to ensure that participants remained attentive to their responses (marked with an asterisk in Table 2). The order of presentation of the items was randomised each participant. Participants were asked to rate their agreement with statements on a 5-point Likert scale (1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree).

5. Ethical approval

The study was approved by the CSIC ethics committee (Internal code: 012/2022). Prior to evaluating the samples, participants were given an information sheet and asked to sign an informed consent form.

6. Data analysis

6.1. Segmentation of participants according to their level of involvement

The positive items on the involvement scale were coded on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). For the negative, or reversed, questions the scores of 1, 2, 4 and 5 were replaced by 5, 4, 2 and 1 respectively. A principal component analysis (PCA) was performed on the item \times participant matrix in order to verify the scale's internal consistency. Two indicators were derived from this analysis: 1) the squared cosine values between each item and the principal components and 2) the Pearson correlation coefficients for all possible pair of items. Items that loaded more on the first principal component than on any other components and that showed an average inter-item correlation greater than 0.2 (Bruwer & Buller, 2013) were considered reliable. All other items were eliminated. A Cronbach alpha analysis was then applied to verify the reliability of the final scale.

After validating the questionnaire's consistency for a total of 14 items, an average score was calculated to represent the overall level of involvement.

A quartile split was then used to segment the participants into four involvement groups: low (L), medium low (ML), medium high (MH) and high (H). To confirm that the four groups were significantly different, a one-way independent measurement ANOVA was carried out using the involvement score as the dependent variable and involvement group as the fixed factor.

A Spearman correlation coefficient was calculated between the involvement score and participants' age, using the five age ranges: < 20, 20–29, 30–39, 40–49, \geq 50.

Chi-square tests were calculated between two age groups ($>$ 30 and $<$ 30 years old) and gender (male, female) to evaluate variable differences within the groups. A two-level categorisation was used due to the limited number of participants in each involvement group.

TABLE 2. List of aroma, taste and, tactile descriptors and the specific aroma terms indicated to explain the main descriptor and rated by the consumers following RATA approach.

Aroma descriptors			
	Descriptor	Specific descriptors	
1	citrus	lemon, lime, grapefruit	
2	tropical fruit	litchi, pineapple, banana	
3	white/yellow fruits	apple, peach	
4	red fruit	strawberry, raspberry, cherry	
5	black fruit	blackberry, blueberry, blackcurrant	
6	floral	rose, violet, jasmine	
7	spice	cinnamon, vanilla, liquorice	
8	dried fruit	prune, dried fig, sultanas	
9	green vegetal	green pepper	
10	vegetal/herbaceous	fresh grass	
11	cooked vegetables	cooked potato	
12	roasted	smoke, coffee, chocolate	
13	reduction	rotten eggs, sewer, rubbish	
14	alcoholic	ethanol, marc	
15	animal	leather, barn, sweat	
16	undergrowth	humidity, mushroom, mouldy	
17	vinegar		
Taste, tactile, and global descriptors			
18	bitter	19	sour
20	sweet	21	drying/astringent
22	watery	23	burning
24	metallic	25	light
26	balanced		

6.2. Effect of tasting condition (can vs bottle) and participants' involvement on perceived quality, liking scores, and RATA profiles

Results were analysed separately for red and white wines.

Perceived quality and liking scores were analysed using two separate two-way mixed design ANOVAs with involvement as the between-subject fixed factor and tasting condition (bottle vs can) as the within-subject fixed factor.

The frequency of RATA terms selected by all participants under the two conditions (bottle and can) was calculated and terms used by less than 10 % of the participants were eliminated. RATA profiles were then analysed using one-way ANOVAs, with packaging condition as the fixed factor and descriptor scores as the dependent variables, both across all participants and as a function of participants' involvement (H, MH, ML and L). Bonferroni pairwise *post hoc* test was calculated for significant effects.

A normalised Principal Component Analysis (PCA) was carried out using RATA data as active variables, and perceived quality and liking scores as illustrative variables.

The individuals were defined as the wines within each condition and involvement group (L-bottle, ML-bottle, MH-bottle, H-bottle, L-can, ML-can, MH-can, H-can).

Data was analysed using XLSTAT (version 2023.1.1, Lumivero, New York), Jamovi (version 2.5, the Jamovi project, 2024), and SPAD 9.1 (Coheris).

RESULTS

1. Segmentation of participants according to their level of involvement

Based on the PCA square cosine and the inter-item correlation threshold of 0.2, items Q2, Q5, Q8, Q9, Q10, Q12, Q13, Q19, and Q20 were removed from the involvement scale. As previously shown by Bruwer and Buller (2013) these items correspond to the reversed items – suggesting some confusion among participants for these items – as well as two items (Q12 and Q13) linked to wine ageing.

The Cronbach's alpha for the 14 remaining items was 0.88, indicating a reliable internal consistency of the scale. Participants were divided into four groups based on the

TABLE 3. List of the 23 items used to evaluate the level of consumer's wine involvement. These items come from the compilation of different studies performed by Bruwer and Buller (2013). Reversed items are marked with an *.

Item	Question
1	I am very interested in the world of wine
2*	Attending wine tastings is not an important activity in my way of life
3	I try to deepen my knowledge of wine
4	I regularly read wine magazines and publications
5*	I drink more wine from a tetra brick than bottled wine
6	I usually choose the wine that goes well with my food
7	I buy wine in specialised shops
8*	I usually drink wine within a month of purchase
9*	I drink wine mainly on special occasions
10*	I rarely decant wine
11	It is important to me to use special tasting glasses when I drink wine
12	I think it is a good idea to have six or more bottles of the same wine preserved for future tasting
13	Wines that can age should be kept for future consumption and not consumed immediately
14	I regularly participate in wine tastings
15	I am willing to spend more than 20 € on a bottle of wine
16	I enjoy tasting different wines
17	Drinking wine gives me pleasure
18	I enjoy visiting wineries
19	I usually bring my own selection of wine to restaurants or bars
20*	The vintage of the wine is not very important to me
21	I choose the wine very carefully
22*	I am not confident in my ability to choose a wine
23	I take the task of choosing a wine very seriously

25th (2.86), 50th (3.36), and 75th (3.86) percentiles of the average involvement score distribution, representing low ($N = 29$, mean = 2.3, standard error = 0.050), medium low ($N = 27$, mean = 3.11, standard error = 0.053), medium high ($N = 35$, mean = 3.53, standard error = 0.046) and high ($N = 34$, mean = 4.21, standard error = 0.047) involvement. ANOVA analysis showed significant differences in involvement score between the four groups ($F = 268$, $p < 0.001$, $\eta^2 = 0.87$). A Bonferroni *post hoc* test showed that all possible group pairings were significantly different ($p < 0.001$).

A significant positive correlation was found between age group and involvement level ($r = 0.40$; $p < 0.001$). Younger consumers were prevalent in the low involvement group, with 76 % under 30 years of age, while in the higher involvement groups, at least 79 % of consumers were over 30 years of age ($p < 0.05$ for the Chi-square test between two groups of age: > 30 and < 30 years old). Conversely, no significant differences between men and women were observed in any of the four groups according to the Chi-square test ($p > 0.05$ in the four cases), indicating a balanced gender distribution among the four groups of consumers.

2. Effect of tasting condition (can vs bottle) and participants' involvement for white wine

2.1. Quality and liking scores

Liking scores were significantly affected by tasting condition ($F = 6.5$, $p < 0.05$) with a significant interaction between tasting condition and involvement level ($F = 3.9$, $p < 0.05$). According to the *post hoc* test, only highly involved participants preferred white wine in a bottle over canned wine (6.0 vs 4.7). For the three other groups the *post hoc* test did not show any significant difference at $\alpha = 5\%$ (5.8 vs 5.8, 6.6 vs 5.4, and 5.7 vs 6.0 for MH, ML, and L involvement respectively). For quality scores, only tasting condition showed a significant effect ($F = 9.1$, $p < 0.01$). All involvement groups found that white wine labelled as sourced from a bottle was better quality than that labelled as from a can (5.8 vs 5.3).

2.2. RATA profiles

Ten terms (prune, green, vinegar, red fruit, undergrowth, black fruit, animal, reduction, cooked vegetable, toasted), were eliminated after being selected by less than 10 % of the participants. The ANOVA results obtained for the

16 remaining descriptors showed that the wine labelled as canned was described as significantly lower in white fruit aroma ($F = 5.5, p < 0.05$) and more metallic ($F = 23.3, p < 0.0001$) than wine labelled as from the bottle (mean white fruit = 1.3 vs 1.8 and mean metallic = 0.68 vs 0.01 for can and bottle, respectively).

This pattern varied according to participants' involvement (Figure 1). High involved participants described the wine in can as significantly more bitter (1.4 vs 0.5, $F = 8.5, p < 0.01$) and astringent/drying (0.9 vs 0.3, $F = 4.4, p < 0.05$), and less light (1.3 vs 2.1, $F = 4.1, p < 0.05$) than the wine in bottle. The medium-high involved participants found canned wine less astringent (0.5 vs 1.5, $F = 7.4, p < 0.05$) while the low involved found it was lower in white fruit (0.9 vs 1.7, $F = 7.7, p < 0.05$) and sweeter (2.0 vs 1.0, $F = 4.9, p < 0.05$). For the medium-low participants, no significant difference was observed for any of the attributes evaluated. All groups found the wine presented in can to be more metallic than when presented in bottle (Figure 1). The ANOVA could not be carried out for this attribute within each subgroup, as the bottle condition registered null values, as opposed to the overall analysis in which a few isolated participants rated the wine in the bottle condition.

2.3. Principal component analysis

The first two components of the PCA explain 65.80 % of the variance (Figure 2). The first component (42.94 % of variance) contrasts the descriptions (burning, astringent, vegetal, aqueous) provided by the low and medium low involved participants of bottled or canned wines to the descriptions (acidic, citrus, alcohol, balanced, floral) of bottled wine provided by the high involved participants and canned wine provided by medium high involved consumers. The second component (22.86 % of variance) is positively correlated with perceived quality and liking. It contrasts the descriptions (metallic, bitter) of the wine presented in can provided by the highly involved participants to that of the wine presented in bottle (white fruit, light) given by medium-high involved participants. This PCA plot confirms the results of the ANOVA, principally that the highly involved participants are particularly influenced by wine packaging, as the can and bottle descriptions are clearly separated (Figure 2a), as opposed to the other groups, for which the can and bottle conditions are closely projected. High involved participants described the white wine presented in bottle with positive descriptors (white fruit, light, floral, balanced, citrus, alcohol) whereas descriptors characterising canned wines were less positive (metallic, bitter) (Figure 2b).

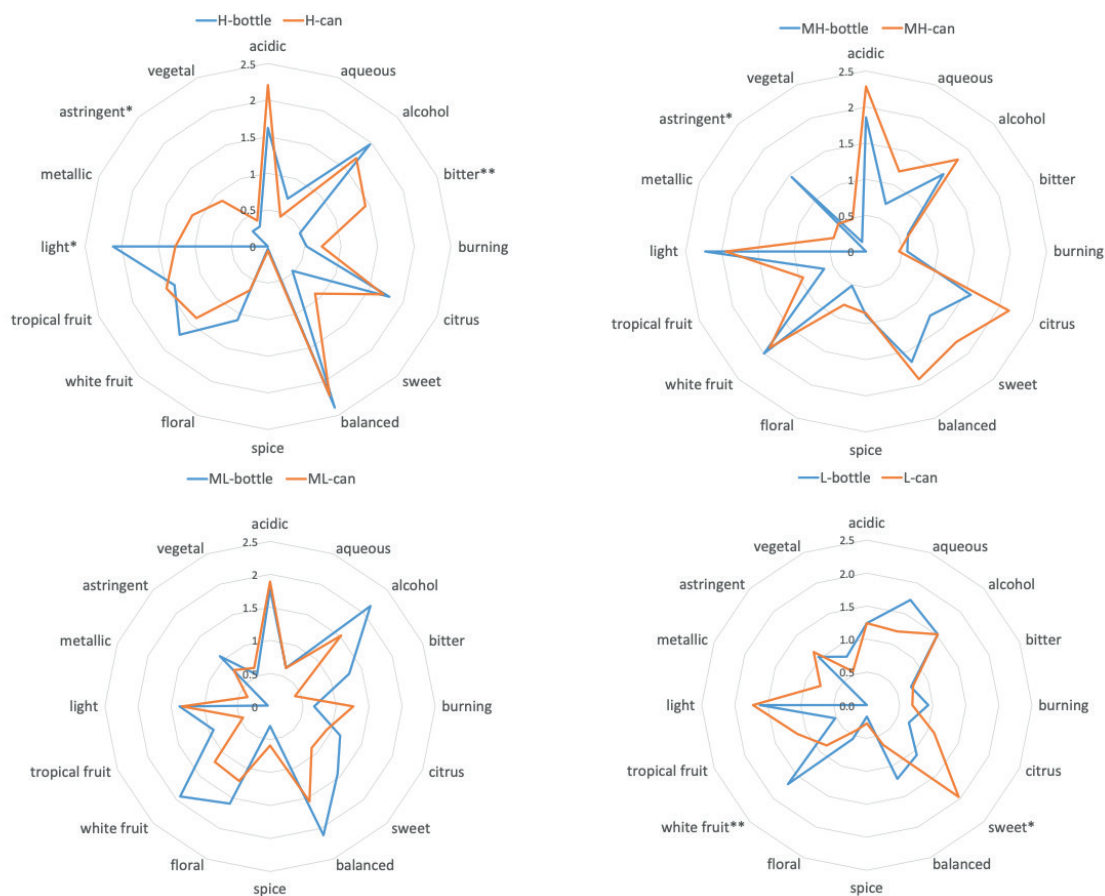


FIGURE 1. Radar plots of the RATA white wine descriptions as a function of involvement level for high (H) medium high (MH), medium low (ML), and low (L) involved participants. The orange lines represent the wine in the can condition and the blue line in the bottle condition.

** = 1 % and * = 5 % (one-way ANOVA with condition (can vs bottle) as fixed factor). Note that the ANOVA could not be calculated in most cases for metallic as the score was null in the bottle condition.

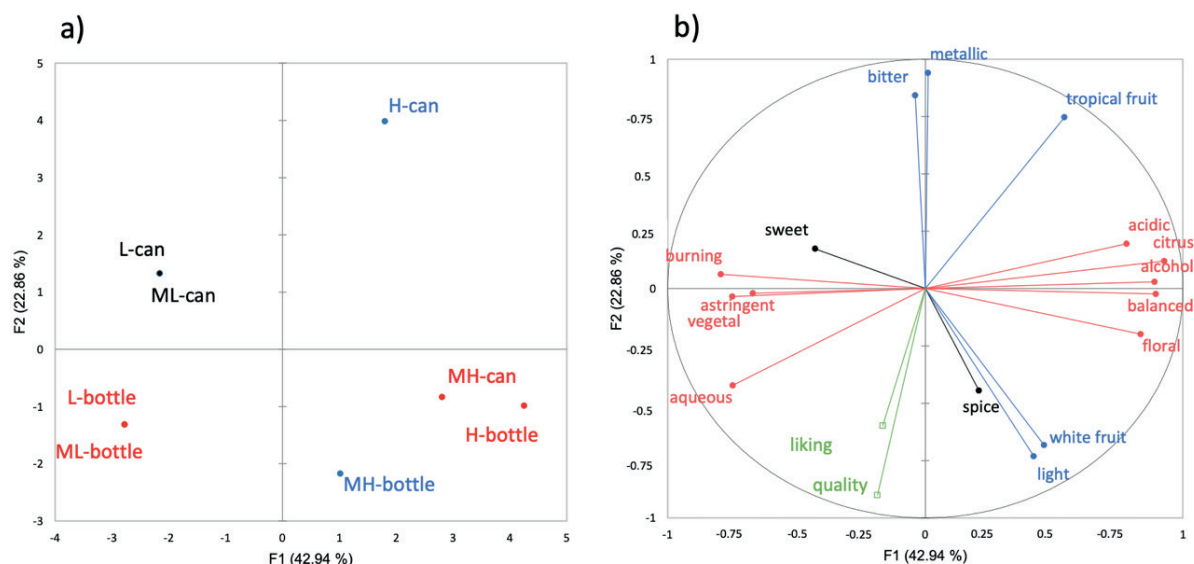


FIGURE 2. PCA of the RATA data for white wine described by high (H), medium high (MH), medium low (ML), and low (L) involvement participants in the bottle and can conditions. The individuals (a) and active variables (b) with a contribution greater than the average contribution are represented in red for the first component and in blue for the second component. The illustrative variables are represented in green.

3. Effect of tasting condition (can vs bottle) and participants' involvement for red wine

3.1. Quality and liking scores

Tasting conditions had a significant effect on both liking ($F = 15.9, p < 0.001$) and quality ($F = 12.3, p < 0.001$) but no interaction between tasting condition and involvement level was observed for either dependent variable. All involvement groups preferred red wine in a bottle wine rather than a can (5.5 vs 4.6 on the average) and perceived it as higher quality (5.3 vs 4.6).

3.2. RATA profiles

Six terms (white fruit, vegetal, reduction, tropical fruit, cooked vegetable) were eliminated after being selected by less than 10 % of the participants. The ANOVA results for the 20 remaining descriptors showed that wine in the can condition was perceived as more aqueous (0.8 vs 0.4, $F = 5.5, p < 0.05$) and metallic (1.0 vs 0.0, $F = 37.8, p < 0.0001$), while lower in black fruit (0.8 vs 1.4, $F = 5.5, p < 0.05$), and toasted (0.3 vs 0.6, $F = 5.1, p < 0.05$) aromas than in the bottle condition.

As for the white wine, this pattern of result is modulated by participants' involvement (Figure 3). High involved participants described the red wine in can as significantly lower in red fruit aroma (1.6 vs 2.8, $F = 6.6, p < 0.05$) and sweeter (0.7 vs 0.2, $F = 4.0, p < 0.05$) than wine in bottle. The medium high involved participants found it more burning (1.3 vs 0.4, $F = 7.0, p < 0.05$) and the low involved participants significantly more metallic (1.5 vs 0.1, $F = 11.2, p < 0.01$) than the bottled wine. Although the ANOVA could not be carried out for the term metallic, three of the four participant groups (null values for the bottle condition) found the wine presented in can to be more metallic than when presented in bottle.

3.3. Principal component analysis

The first two components of the PCA account for 57.41 % of the variance (Figure 4). It should be noted that the PCA circle of correlation shows greater complexity for red wines than for white wines, with multiple descriptors (*e.g.*, vinegar, acidity, and toasting) contributing across components 1 and 2. The first component (40.16 % of variance) opposes negative descriptions (animal, aqueous, bitter, metallic, undergrowth) of the canned wine provided by the low involved and medium low participants to positive descriptions (black fruit, red fruit, citrus, spice, toasted, acidic) of the bottled wine provided by the high involved participants. This component is correlated with perceived quality and liking. The second component (17.25 % of variance) is mainly driven by the descriptions of the red wine presented in bottle provided by low involved participants, and confronts the dominant prune descriptor to terms such as alcohol and astringent.

DISCUSSION AND CONCLUSION

The findings in this study support H1, which posits that bottled wine is perceived as significantly higher in quality than canned wine (for white: 5.8 vs 5.3; for red: 5.3 vs 4.6), regardless of wine type for traditionalist consumers. A parallel tendency emerges in the liking scores of bottled red wine (5.5) compared to canned red wine (4.6). Concerning white wine, consumer liking is influenced by consumer wine involvement, as predicted in H2. A higher level of liking for bottled over canned wine is observed among highly involved consumers (6.0 vs 4.7). However, the majority of consumers do not exhibit any discernible differences in their liking with regard to white wine packaging. Consequently, young white wine could be considered a viable candidate for alternative packaging, such as aluminium cans, for traditional Spanish consumers.

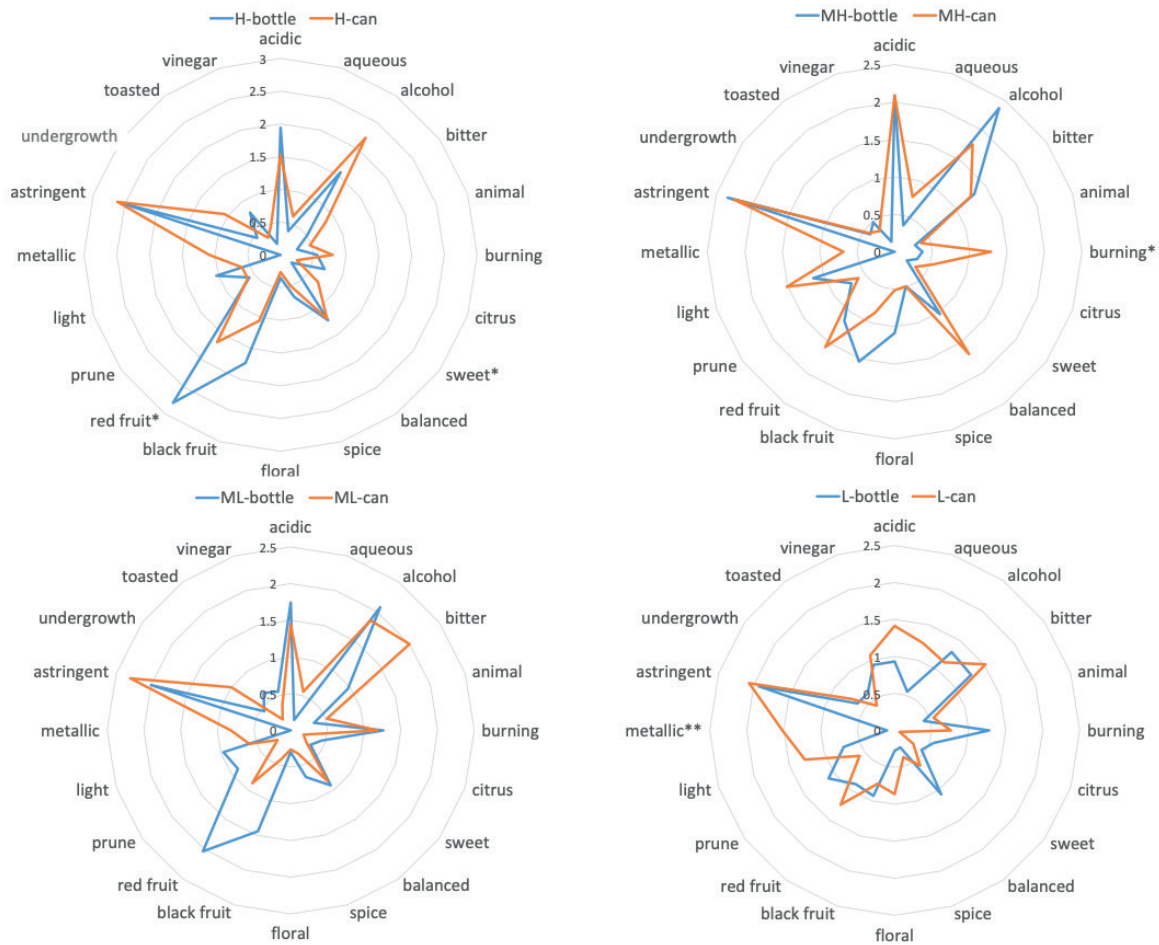


FIGURE 3. Radar plots of the RATA red wine descriptions as a function of involvement level for high (H) medium high (MH), medium low (ML), and low (L) involved participants. The orange lines represent the wine in the can condition and the blue line in the bottle condition.

** = 1 % and * = 5 % (one-way ANOVA with condition (can vs bottle) as fixed factor). Note that the ANOVA could not be calculated in most cases for metallic as the score was null in the bottle condition.

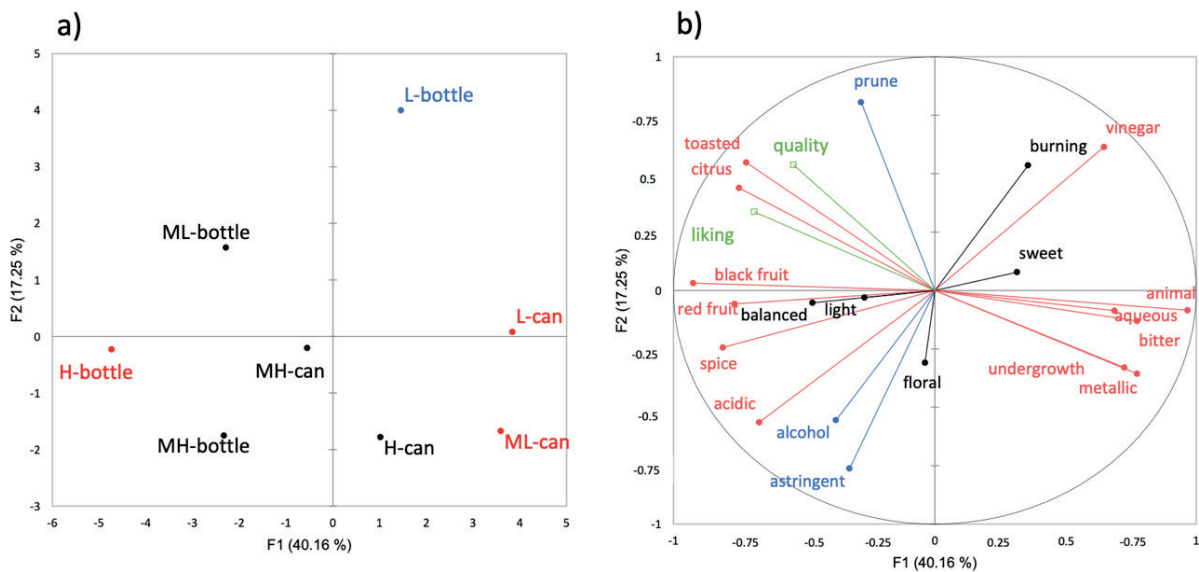


FIGURE 4. PCA of the RATA data for red wine described by high (H), medium high (MH), medium low (ML), and low (L) involvement participants in the bottle and can conditions. The individuals (a) and active variables (b) with a contribution greater than the average contribution are represented in red for the first component and in blue for the second component. The illustrative variables are represented in green.

The perceived higher quality of bottled wine, compared to canned wine, can be explained in terms of congruence between the packaging and the product (*i.e.*, image mold). It should however be noted that the glass bottle presented in this study does not correspond to the traditional 750-mL glass bottle, but a 125-mL bottle closer in volume to the 200 mL can. It seems thus, as already shown by Orłowski *et al.* (2022), alternative packaging formats that closely resemble traditional glass bottles, such as the miniature glass bottles used in the present work, are perceived as more congruent with traditional packaging formats. The greater congruency of glass bottles for wine presentation supports the overall negative quality perception of wines in aluminium cans. These findings align with previous studies conducted in other traditional markets, such as Italy (Ruggeri *et al.*, 2022) and among more innovation-prone consumers in the USA (Orłowski *et al.*, 2022).

It is notable that for white wine, there is no straightforward correlation between perceived quality and product liking. Rather, consumer liking is contingent upon the level of involvement with wine. This effect can be attributed to the desire for unique consumer products (DUCP). This concept was employed by Lynn & Harris (1997) and Orłowski *et al.* (2022) to measure variations in consumer tendencies to acquire consumer goods, services and experiences that are not widely owned by others. Orłowski *et al.* (2022) posit that innovative packaging, namely aluminium cans, can engender a negative liking among low-DUCP consumers (*i.e.*, traditionalist and highly involved consumers). In contrast, high-DUCP consumers do not demonstrate significant differences in their likings between traditional (*i.e.*, bottled wine) and non-traditional (*i.e.*, canned wine) packaged wine. It is noteworthy that this liking for distinctive products is exclusive to white wine, and does not to red wine. This result demonstrates the versatility of white wine packaging for the majority of consumers (except for highly involved participants), while red wine is consistently preferred in a bottle rather than a can. This can be attributed to expectations formed by the study participants around these two wine categories based on their previous wine knowledge. This effect is supported by Morrot *et al.* (2001) for the influence of colour on wine aroma description. The authors defined this phenomenon as a “perceptual illusion”, in which wine colour influences its odour description. In the present study, all wines originated from a region where quality is designated according to the wine ageing process, which is performed in two distinct stages. The majority of red wines produced undergo minimum two years of ageing: one year in oak barrels and one year in bottle. In contrast, white wines in the region are typically younger, undergoing neither barrel nor bottle ageing. This may contribute to similar likings for bottled and canned white wine, which differs from trends observed for red wine. This hypothesis merits further investigation, including additional experiments with multiple red and white wines to assess the suitability of different wine categories, including aged and non-aged wines, for cans.

The present work also supports previous works by confirming H3. Canned wine, regardless of the wine type, was perceived as more metallic ($p < 0.0001$; $F = 23.3$ for white; $F = 37.8$ for red wine) and exhibited significantly lower fruity notes ($p < 0.05$; $F = 5.5$ for both white and red wines) compared to bottled wine – mainly white fruits for the white wine and black fruits for the red one. On one hand, this effect could be attributed to cross-modal integration or sensory transfer as defined by McGurk and McDonald (1976). This effect is defined as the process of linking inputs from disparate sensory modalities in order to facilitate perception. Accordingly, the visual cues elicited by the distinct packages interact with flavour stimuli to modulate perception, as reviewed by Spence (2015). The perception of canned wines as more metallic may be attributed to a semantic correspondence where the same term is used to describe different dimensions (Spence, 2022). However, it is shown that the differences transfer among consumers, and the visual-flavour associations are consequently influenced by the level of consumer involvement. This can be attributed to prior perceptual experience, as evidenced by cross-cultural effects (Spence, 2022). Nevertheless, confirming the sensory transfer between the canned wine (visual stimuli) and metallic aroma (flavour stimuli) necessitates further research to substantiate the actual physiological effect of visual stimuli on flavour perception, which appears implausible. An alternative explanation for the effect of the packaging on sensory description is that consumers may have a pre-existing idea of the metallic taste of canned wine. This phenomenon has been observed in the case of canned beer, where it was found that consumers construct a mental expectation of the taste of the product. This mental image has the potential to distort the actual sensory experience (Cerjak *et al.*, 2010). Given that all wines in the present experiment were bottled and never in contact with cans, it may be posited that this effect is based on top-down processing. In other words, wine perception can be influenced by prior knowledge, experiences, and expectations, thereby affecting the interpretation of sensory information (Gregory, 1970). The limited shelf-life of canned wines, resulting from aluminium migration into the wine and oxygen management (Versari *et al.*, 2023), may contribute to the formation of consumer expectations and, consequently, flavour perception.

It can be concluded that alternative packaging still holds potential in the wine industry. This acceptance may be reinforced by the demand for a more sustainable industry. Evidence suggests a clear interaction between sustainability and consumer behaviour (Csiba-Herczeg *et al.*, 2023; Orłowski *et al.*, 2022). This provides opportunities for future research targeting consumers and markets inclined to prefer sustainable solutions and unique products. However, it is also important to recognise that innovative solutions must address wine-can interactions and aluminium migration during ageing, which is facilitated by wine’s acidity. As suggested by Versari *et al.* (2023), the next generation of cans must incorporate cross-linked polymers to mitigate aluminium migration during ageing.

Despite the merits of the study, certain limitations restrict the generalisation of the results: firstly, the participants belong to a traditional wine culture, D.O.Ca. Rioja, where oaked red wines are the most widely consumed. This could have resulted in a participant sample with a relatively high involvement level and familiarity with a specific wine category. Secondly, the study was carried out using only two young wines, one from each category (white or red). Further work should be conducted with consumers from regions with lesser wine-producing tradition and include a wider range of wine categories. Thirdly, an explicit evaluation of consumers' traits, particularly their desire for unique consumer products, would also provide further insights into the perception of canned wines.

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