IVES OENO One vine & wine

DOI: https://doi.org/10.20870/oeno-one.2025.59.1.8367

OPEN ACCESS

ORIGINAL RESEARCH ARTICLES

Less is more: towards a discrepancy in the representation of 'no added sulphite' wines among French professionals and consumers

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Article number: 8367

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Associate editor:
Sue Bastian

Received:
29 October 2024

Accepted:
5 February 2025

Published:
21 February 2025

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ABSTRACT

As an emergent phenomenon in the wine market, 'no added sulphite wines' (NAS) are an ill-defined category for both consumers and professionals. This study aimed to identify the representation of NAS wines for French wine consumers and professionals and to understand how familiarity and expertise could modulate their representations. An online free word association task was used. Participants had to promptly verbalise the first five terms that came to mind for "NAS wines" and to rate both the importance and the connotation of each generated term. A total of 319 consumers representative of French wine consumption and 540 wine professionals from different French wine-producing areas were recruited. Based on the prototypical analysis, we calculated quantitative indexes from the data to identify the content of consumers' and professionals' representation, coupled with a co-occurrence analysis to determine the link between the different terms. By comparing the level of expertise, results showed a contrasted representation of NAS wines between French wine consumers and professionals. Consumers have a positive representation whatever their level of familiarity, mainly based on natural perception and health benefits. Professionals have a negative representation, mostly focused on defects, that is modulated according to the level of familiarity. For professionals, it is not so much the definition of the wines that change but the degree of importance given to the defects. Finally, these results confirmed the need for information and clarity to enable consumers to better understand what NAS wines are and to stimulate professionals to consider a common technical acceptability.

KEYWORDS: no added sulphite wines, mental representation, consumers, familiarity, expertise, word association task

INTRODUCTION

Faced with strong societal demand in a competitive context, food and beverage products are constantly evolving to offer more natural, healthier and environmentally friendly products, mostly driven by technological advancements and consumer preferences (Blezat Consulting, Credoc, & Deloitte Développement Durable, 2017; The European Commission, 2019). This has been reflected for several years by the appearance of the concept of the "Clean Label" and the emergence of "free from" claims on products: additive-free, no added sugars, no colouring agent and pesticide-free (Asioli *et al*., 2017). The wine market is no exception to this trend, especially with the 'no added sulphite' claim (Delmas & Grant, 2008; Maykish *et al*., 2021; Vecchio *et al*., 2023). According to Immélé & Diringer (2012), the presence of the mandatory statement "contains sulphites" for all wines containing more than 10 mg/L of sulphites in 2011 (Réglement Européen, 2011) has created an interest in wines without added sulphites. To meet this demand, numerous initiatives have been undertaken to reduce the sulphite dose or to eliminate it completely (Charrier *et al*., 2021; Guerrero & Cantos-Villar, 2015). The literature points to a real challenge in the sense that sulphites have an important place in modern oenology because of their antioxidant, antimicrobial and antioxidasic actions that limit certain sensory characteristics (Divol, 2012; Ribéreau-Gayon *et al*., 2021). While looking for technical alternatives to sulphiting, some wine professionals have opted for less interventionist strategies, especially with natural wines claiming a limited use of inputs in general, and sulphites in particular (Alonso González & Parga-Dans, 2020). In France, the result is the coexistence of wines without sulphites produced in various specifications: conventional, organic, biodynamic and "natural" (*i.e*., as defined by the rules of French winegrower's associations, called "vin méthode nature" in French) wines, with unequal highlights of the absence of sulphites on the labels (Honoré-Chedozeau *et al*., 2022). In this context, there is very little knowledge about the perceptions of the wine industry by both wine professionals and consumers, regarding the representations associated with no added sulphite wines. From a professional perspective, a preliminary work by Honoré-Chedozeau *et al*. (2022) with French producers shows various motivations to produce without sulphites whether from a commercial, technical, philosophical, or environmental point of view. On the marketing side, we observe the emergence of wine merchants or journalists specialised in natural wines and/or sulphite-free wines (Alonso González & Parga-Dans, 2023). The fact remains that there is a debate about the presence of possible recurrent defects in the absence of this preservative, notably *Brettanomyces*, mousy and oxidation characters. Pelonnier-Magimel *et al*. (2020) demonstrate the prevalence of aromatic deviations in Bordeaux PDO wines produced without sulphites. Waterhouse (2015) from Davis University mentions that sulphite-free wines are very perishable, and often have unusual aromas. In addition, Charrier (2015) indicates that given the current state of knowledge and the technical resources available to produce wine, producing NAS wines remains a risky practice that is not recommended, especially without the acceptance of new wine styles. In contrast, others defend the existence of these characteristics as markers of "character, personality, uniqueness" while discussing the intensity of these (Alonso González & Parga Dans, 2018; Grainger, 2021; Immélé & Diringer, 2012).

From the consumer side, numerous studies focusing on the willingness to pay and the perception of wines labelled as 'no sulphites added' show a favourable opinion of Spanish, Italian and American consumers for NAS wines with possible variations depending on the consumer profile (Amato *et al*., 2017; Costanigro *et al*., 2014; D'Amico *et al*., 2016). French consumers also seem to have a positive perception of sulphite-free wines (Raineau *et al*., 2023; Symoneaux, 2020). Recently, Honoré-Chedozeau *et al*. (2022) studied the mental representations of French wine consumers associated with NAS wines by using a free word association task. They associate these wines with three main categories of terms: natural, organic and healthy. But this study is questionable by the consumer target studied which was not representative of French wine consumers.

Given the complexity of the NAS wine market and the emerging divergence between professionals in winemaking practices, understanding the mental representation of both wine consumers and professionals seems therefore to be an interesting first step to explore. Representation is how an individual constructs their own reality in mind through an object or a concept in the absence of it (Gómez-Corona & Rodrigues, 2023). This individual construction can be shared at a collective scale, by grouping together individuals according to their level of expertise and/or culture regarding the object or concept being studied, as already shown by past studies in the wine field (Mouret *et al*., 2013; Rodrigues *et al*., 2015; Urdapilleta *et al*., 2021). The study of representations has led to a great deal of work in both social and cognitive psychology, that aimed at identifying both the content of the information, opinions, attitudes and beliefs stored in memory for an object or a concept and how they were organised (Manetta *et al*., 2012). Those studies permitted to provide several methodologies to access people's representation by using interviews, word association, observations or documentation tasks (Abric, 2003). For instance, by using a free association task with the word "wine" as an inductor, Mouret *et al*. (2013) demonstrated the effect of both culture and expertise on the social representation of wine by comparing wine consumers and professionals from France and New Zealand. In food sciences, this free word association task became very popular and gained importance in recent years to explore and understand consumers' behaviours and attitudes through their beliefs, thoughts, feelings and expectations towards different categories of food and beverages or ill-defined concepts. Recently, Rojas-Rivas *et al*. (2022) reviewed 74 publications using a word association task between 2000 and 2020, with the largest number of studies published in 2019 and 2020 and a recent update concerning the validity

and stability of results obtained (Rojas-Rivas *et al*., 2023). In their reviews, they demonstrated a diversity of themes explored with consumers, mostly about traditional foods, meat and seafood products, conceptualisation, alcoholic and non-alcoholic beverages, labelling, unfamiliar foods and other food categories. In those studies, they also highlighted that the main data analysis focused on classical quantitative techniques (*i.e*., the Chi-square test and Correspondence Analysis are the most used among these studies) rather than qualitative ones as used in social psychology (*e.g*., a structural approach by the calculation of indexes and co-occurrence analysis based on graph theory), or even a combination of these. As this method is rooted in psychological studies, and is used by social psychology for the study of mental representations (Abric, 2003; Degenne & Vergès, 1973; Moscovici, 2014), we wanted to explore a different approach to exploring and interpreting word association data which has been little examined in sensory science to date (Bisconsin-Júnior *et al*., 2020; Gómez-Corona *et al*., 2016; Rodrigues *et al*., 2015). This could be seen as an alternative way for data analysis, providing, from our point of view, a richer level of information about both the content and the structure of mental representations, based on the language of consumers by a combination of quantitative and qualitative analyses. Indeed, when exploring the structure and the content of mental representations of Beaujolais wines by wine professionals and consumers through a categorisation task of labels, Honoré-Chedozeau *et al*. (2017) demonstrated an effect of both the level of expertise and familiarity with Beaujolais wines on the flexibility of thought. Indeed, the knowledge representation of experts was flexible, by leading different ways of categorisation for Beaujolais wine labels, while that of familiar consumers was rigid, it was fragmented for unfamiliar consumers.

By considering all these results, the overall objective of the present study was to determine the representation of NAS wines for both French wine consumers and professionals. Thus, we compared the mental representations of two levels of domain-specific expertise: wine professionals and wine consumers. As NAS wine is both an ill-defined and emergent category in the French market, we evaluated how different levels of familiarity and expertise with NAS wines could modulate the content of the representation for each group. To address these questions, we used two types of tasks. First, we used a free word association task to access the content of the NAS wine representations of each group. Then, by following our social psychology approach, we designed a specific questionnaire based on the Distance to the Object (DO) questionnaire proposed by Urdapilleta *et al*. (2021), to determine the level of familiarity of participants according to three main dimensions that included involvement, knowledge and practice/exposition with NAS wines particularly. We hypothesised that: 1) the content of mental representations of NAS wines would differ according to the level of wine expertise and 2) the more the people were familiar with NAS wines, the more positive their representations.

TABLE 1. Sociodemographic profile and wine consumption of consumers.

Type of panel	Consumers (% - n = 319)				
Gender × Wine Consumption × Age	Less than 35	35 to 49	50 to 64	65 and more	
Male					
Occasional	6.6	10.7	8.2	6.3	
Regular	1.9	4.1	5.0	6.3	
Female					
Occasional	7.5	11.3	10.3	8.8	
Regular	2.2	2.8	3.1	5.0	
Socio-professional group	Employees/ Manual workers	High-level profession	Unemployed	Retired	Others
	29.8	28.5	10.0	31.0	0.6
Place of living	Paris Region	North West	North East	South West	South East
	20.1	22.6	20.7	14.1	22.6
Type of living place	Urban	Rural			
	73.0	27.0			
Type of wine consumed	Don't know if consume	0 %	1 to 25 %	More than 25 %	
NAS	38.9	15.4	19.7	26.0	
Organic	8.8	23.5	36.1	31.7	
Natural	32.3	15.7	24.5	27.6	

MATERIALS AND METHODS

1. Participants

The study was conducted in France from December 2022 to January 2023 thanks to a national survey with two targets of participants: wine consumers and wine industry professionals.

1.1. Wine consumers

A total of 319 wine consumers were selected based on a quota method to be representative of the population of French wine consumers (FranceAgrimer, 2023). Table 1 presents the demographics and wine consumption characteristics of the participants. In addition to the selection criteria (gender, wine consumption, age, socio-professional group, place of living), consumers were asked to stipulate the proportion of NAS, organic and natural wines in their wine consumption. It must be noted that 38.9 % of the wine consumers did not know if they consumed NAS wines or natural wines (32.3 %). Equally, around 25 % of consumers declared that NAS and natural wines represented more than 25 % of their wine consumption.

The online survey was administered to consumers by PANELABS, a French market research company, which followed all French regulations on data protection, and the ESOMAR International Code of Market Research. Participants responded voluntarily and were paid a symbolic amount once they completed the survey. Data were anonymised before analysis.

1.2. Wine professionals

A total of 1004 wine professionals answered the online survey. Only 540 participants who had answered all questions were kept for analysis. To reach a varied professional audience at a national scale, they were contacted *via* several interprofessional and professional association newsletters, from local to national ones through the different French wine-growing areas, offering to answer a questionnaire on wine, without mentioning NAS wines in the topic. We selected different types of wine experts (*i.e.*, makers, sellers and critics) to be as representative as possible of the expertise field. In this way, specific questions were addressed in relation to their job's objectives in terms of producing, advising, selling and

TABLE 2. Sociodemographic profile and job activity of professionals.

Type of panel	Professionals (% - n = 540)				
Gender x Age	Less than 35	35 to 49	50 to 64	65 and more	
Male	10.7	17.4	22.0	5.9	
Female	15.2	15.2	12.0	1.5	
Socio-professional group	Employees/ Manual workers	High-level profession	Unemployed	Retired	Others
	12.78	77.96	2.22	4.44	2.59
Origin of wine-producing activity	Burgundy-Beaujolais- Jura-Savoy	Alsace-East France	Bordeaux	Champagne	Languedoc-Roussillon
	18.7	5.7	13.1	12.4	16.7
	Rhone Valley-Provence	South-West France	Loire Valley	Outside France	Others
	28.3	7.2	18.0	7.6	6.9
Type of professional activity	Wine producer and seller	Wine producer	Wine seller	None of the two*	
	35.7	28.3	10.6	25.4	
Holding DNO diploma**	Oenologist	Non-Oenologist			
	48.7	51.3			
Type of wines produced/sold among producers and sellers (n = 403)	0 %	1 % to 25 %	25 % and more		
NAS	43.2	46.7	10.2		
Organic	15.4	32.5	52.1		
Natural	62.5	29.8	7.7		
Conventional	16.6	9.4	73.9		

*Including most wine traders, journalists, critics and retailers.

**The National Diploma of Oenologist (DNO) is a special two-year academic training course at the university graduate level, taught in France under this specific name for the accreditation of professional oenologists.

promoting/recommending. Table 2 presents the demographics and production/selling characteristics of the participants.

It is not possible to evaluate how representative this sample is since no national statistics concerning wine professionals exist. Nevertheless, the distribution between age and gender, the affiliation to a French wine-producing area in which the professional works and the type of professional activity with wine producers, sellers and prescribers allows for interesting diversity. Among the 403 wine producers and/or wine sellers, 43.2 % do not produce/sell NAS wines. This type of wine represents more than a quarter of their production/selling for only 10 %. Participants responded voluntarily and were not paid once they completed the survey. Data were anonymised before analysis.

2. Procedure

When entering the online questionnaire, professionals and consumers were only informed that the topic was about wine perception and consumption. The questionnaire was composed of two specific sections: one concerning a free word association task to determine mental representations of NAS wines and a second one about DO questions, to determine their level of familiarity with NAS wines (*i.e.*, involvement, knowledge and practices/exposition about NAS wines specifically).

2.1. Free word association task (FWAT)

Entering the questionnaire, a warmup exercise with two words ("boat" first, and "forest" second) was presented to the participants. The first step of the exercise was to write down the first five words or expressions that came spontaneously to their mind. After this warm-up phase to familiarise themselves with the free word association task, the NAS-induced word was submitted to them. Then, for each word produced, participants were asked to rank the terms evoked according to their importance in relation to the induced word, starting from the most (rank 1) to the least (rank 5) important term. After that, they also had to rate each term evoked, according to their connotation, with the induced word on a 7-point Likert-type scale, anchored from "Very negative" (–3) to "Very positive" (3), with 0 labelled as "neither negative nor positive".

2.2. Distance to the object (DO) questionnaire

A specific questionnaire based on the DO survey proposed by Urdapilleta *et al*. (2021) was designed to determine the level of familiarity of participants according to three main dimensions, integrating levels of involvement, knowledge and practice/exposition with NAS wines particularly. In Urdapilleta *et al*. (2021), the DO questionnaire was composed of 22 questions including four reversed, and developed on wine in general, for which the same questions were asked whatever the participants' profile (*i.e.*, wine professional or consumer). In the present study, the DO questionnaire was adapted to NAS wines to be more specific and avoid trivial questions. For instance, the first question on the integration of wines in relation to gastronomy no longer makes sense for NAS wines because of the ratio of scale, as being a niche wine market. So, we decided to change the scale by replacing "gastronomy" with "the world of wine" (Table S1). Some questions were also adapted or deleted to take account of the different profiles of participants, consumers vs professionals, to avoid triviality, redundancy between modified questions, or less appropriate issues relating to wine expertise. Finally, 17 and 14 questions were randomly addressed to consumers and professionals respectively. Table S1 presents all the questions we used for each dimension and each panel that derives from our adaptation of Urdapilleta's questionnaire.

2.3. Data analysis

Given that our questions concern both a global strategy linked to the FWAT data and a specific strategy linked to the DO questionnaire data, two successive strategies of analysis have been carried out. The FWAT analysis was first carried out at a panel scale to determine and compare the content of the mental representation of consumers and professionals for NAS wines. Then, the DO questionnaire analysis was carried out to divide each panel into sub-groups according to their level of familiarity with NAS wines. This division was necessary to investigate how familiarity could modulate the content of the representations.

2.3.1. Free word association analysis

All the terms collected were first cleaned by correcting those with obvious typing or spelling errors. For each corpus, terms were lemmatised by reducing all words to their roots Bécue-Bertaut *et al*. (2008), and then were categorised through a triangulation process which consists of grouping together terms and expressions that share the same meaning (Apostolidis, 2006). This process was done by four individual people, who then discussed it together to reach a consensus, supervised by one researcher to avoid over-interpretation. Considering the level of specificity in the vocabulary used between wine professionals and consumers due to expertise, this categorisation process was carried out on the two corpora separately. This process was conducted by the same people and at the same time for both corpora. The labelling of each category was based on the diversity and distribution of terms. The same label was used for categories when the generated words were similar or synonyms, to better compare themes or concepts evoked by each panel for the induced word. The position of the different terms on the list of each participant was conserved in the final matrix. Table 3 presents the list of the final categories according to their similarity or difference of meaning between the two corpora. In this table, the categories Nature (for professionals) and Natural (for consumers) were not merged as the first one refers to a product (*e.g.*, *nature wine*, *wine known as "natural"*, *wine almost "nature"*) while the second implies a concept (*e.g.*, *natura*l, *naturalness*, *purity*) with only five terms related to wine explicitly. This observation emerges as an interesting nuance to highlight as it is not at the same level of interpretation.

Following a socio-psychological approach, we used a prototypical analysis of the generated words to determine the hierarchical structure of NAS wine representation per panel. This is a crossing between the frequency of citation and the average rank of importance. It could be completed

TABLE 3. List of the categories (in bold) resulting from the categorisation process of the terms and expressions generated by the two panels. (part 1/2)

Categories	Most recurrent terms associated with each category	Main evoked theme
	Common to both panels	
Allergy	Allergen, allergy, allergen-free	Allergy-related concerns
Colour	Red, white, rosé, colour, white wine, red wine	General wine colour inferences
Ecological	Respect, ecology, ecologic, eco-friendly, environment, responsible, sustainable	Ecological concerns
Fashion	Fashion, trendy, fashionable, fashion trend, modern	Marketing trend
Good	Good, pleasure, tasty, cool, savoury, interesting, wine quality	Positive hedonic judgment
Headache	No headache, migraine, headache, without headache, less headache	Expressing a migraine-triggering factor
Healthy	Health, healthy, good for health	Health concerns
New	New, novelty, discovery, future	Expressing novelty
No Input	Preservative-free, sulphur-free, input-free, additive-free, chemical-free, SO2-free, unprotected	A list of non-added input types
Not knowing	I do not know, nothing, unknown	Expressing a lack of knowledge
Organic	Organic, biodynamic, organic wine	Organic and biodynamic certifications
Professional	Winegrower, winegrower, wine cellar, cellar	Related to the type of wine expert or place
Short storage	Storage, fast storage, short storage, to drink rapidly	Projection on wine conservation
Sulphur	SO2, sulphur, sulphite, protection	Evoking the chemical compound or properties
	Specific to professional panel	
Aversion	Not great, useless, bizarre, a step backwards	Incisive terms
Bad	Not good, bad, poor quality	Negative hedonic judgment
Boho	Boho, bohemia	Catchword for a popular expression linked with wealthy social class and sustainability attitudes
Consumer	Consumer, society	Evoking consumers
Defects	Oxidation, defect, oxidised, Brettanomyces, deviation, unstable, vinegar, oxidative, mousy taste	A list of oenological deviation
Difficult	Difficult, complicated, challenge, difficult to make, difficulty	Difficulty in producing wines
Distrust	Distrust, danger, caution, scam, dangerous	Arousing negative feelings
Doubt	Doubt, why not, to be seen, confusion, doubtful	Raising doubts
Fruity	Fruit, fruity, aroma, aromatic, expressive	Expression of fruity and aromatic terms
Hygiene	Hygiene, clean, cleanliness, healthy grapes	Hygiene concerns
Marketing	Marketing, communication, societal demand, trade, niche, niche market	Marketing concerns
Microbiology	Microbiology, yeast, microorganism, alive	Related to microbiological activity
Nature	Nature, natural, nature wine, natural wine	Referred to a natural-based wine product
Process	Winemaking, oenology, input, technology, evolution, stability, work	Interventionism in the winemaking process
Regulation	Regulation, quality label, label, mention	Reference to labelling regulations
Risk	Risk, sensitive, risky, random	Risk-taking
Sensory characteristics	Light, taste, young, freshness, delicate, youth, balance	Expression of specific sensory terms
Technical mastery	Technic, mastery, technical skills, precision	Technical wine expertise
To be tasted	Drinkability, curiosity, discovery, tasting, curious	Inspiring a desire for discovery

TABLE 3. List of the categories (in bold) resulting from the categorisation process of the terms and expressions generated by the two panels. (part 2/2)

	Specific to consumer panel	
Better	Better, better taste, that is better	Superlative terms
Different	Different, rare	Expressing distinctiveness
Digestible	Digest, digestion	Related to the digestive properties of food
Expensive	Expensive, price, more expensive	Economical concerns
Geography	Bordeaux, cru, Beaujolais, region, Alsace wine	Name of wine-producing area or appellation
Natural	Natural, nature, pure	Refers to a natural-based concept
Nothing	Nothing to report	Linked to a limited answer
Process	Grape, vine, alcohol, bottle, harvest, wine	Basic terms relative to the winemaking process or wine sector
Quality	Quality, qualitative, qualitative wine	Expressing qualitative expectations
Quality label	Label, AOC, PDO	Related to quality signs
Respect	Respect, respectful, seriousness	Product value concerns
Sceptical	Bof, bizarre, fear	Expressing scepticism
Sharing	Party, meal, convivial, aperitif	Expressing a value or wine-tasting contexts
Terroir	Terroir, tradition, authentic, craft, know-how	Related to the terroir concept
Wine taste	Taste, tasting, sweet, savour, odour, aroma	Expression of general sensory terms

by connotation indexes to determine positive, neutral, or negative evaluation by averaging all the rates given by participants to each evoked term. After the categorisation step, three quantitative indexes were thus calculated for each panel, from the data for each category, to determine the categories that emerge during the FWAT among wine consumers and professionals towards NAS wines. This was done by calculating the frequency of citations per term, the average rank of importance and the polarity and neutrality indexes (de Rosa, 2002). The polarity index (Pi) permits one to determine if categories had positive, neutral, or negative evaluations of the NAS word, by calculating the difference between the number of positive and negative evaluations of each term within a category, which was then divided by the number of total citations of the category. The Pi index ranged from –1 to +1. Values between –0.04 and +0.04 indicate that negative and positive evaluations were equivalent. Values below –0.04 indicate that more negative evaluations were used, and values above 0.04 indicate that more positive evaluations were used. For values between –0.04 and +0.04, a neutrality index (Ni) was calculated as a complement to determine whether this neutrality was the result of an equivalent proportion between negative and positive evaluations, or of most neutral evaluations by participants. This index is a ratio between the sum of the difference of neutral and positive evaluations, and negative evaluations of each term within a category, which is then divided by the number of total citations of the category, as indicated by de Rosa (2002). This index follows the same range as the polarity index, a value below –0.04 indicates that few words within the category were evaluated as neutral, and a value of above 0.04 indicates that most words were evaluated as neutral.

A cut-off point was then calculated for the frequency of occurrence and the average rank of importance, to separate the categories of the representation that belong to the core of the representation (central zone) and the peripheral areas. For frequency of occurrence, the cut-off is determined first, by ordering all the frequencies in a decreasing order and then, by choosing the value for which the difference between two successive frequencies is maximal (Vergès, 1992). For the average rank of importance, the cut-off is determined by averaging all the average ranks across categories (Abric, 2003). This analysis was performed using the free software R, version 4.3.2 (R Core Team, 2015).

FWAT data was also used for a co-occurrence analysis to better visualise the most emerged categories and their interrelations to each other. This analysis was based on the graph theory (Degenne & Vergès, 1973) for which a co-occurrence index is calculated to determine the number of times two categories of words appear at the same time in the list of the five words evoked by each participant. The final graph represents a co-occurrence tree by using Kamada and Kawai's (1989) spring-based algorithm to both optimise and visualise the central elements being taken as intermediaries for the other categories of words. In this output, the nodes represent a category for which the size is proportional to their frequency of citation. The link between two categories corresponds to the interconnections between two categories, and its thickness is proportional to this co-occurrence. After analysis, the average rank of importance and connotation (illustrated by both polarity and neutrality indexes) were reported on the final graph, so that all the information is projected onto the same figure for each corpus. These analyses, carried out at a panel level, were repeated at a sub-group level, where necessary, within each panel, to

evaluate the effect of familiarity on the structure of mental representation. The participants from each panel were thus segmented according to the DO questionnaire analysis.

This analysis was performed on the open-source text analysis software IraMuTeQ version 0.7 alpha 2 (Ratinaud, 2009) based on the R statistical software version 4.1.3 (R Core Team, 2015). Only the categories with a minimum of citations evoked by at least 5 % of participants were considered for analysis to avoid the loss of valuable information (Guerrero *et al*., 2010; Vidal *et al*., 2013).

2.3.2. DO questionnaire analysis

The reverse questions of the DO questionnaire were first recoded. Then, the reliability of the DO questionnaire was assessed separately for consumers and wine professionals with Cronbach's alpha (Cronbach, 1951; Cronbach & Meehl, 1955). This analysis was carried out with all items simultaneously and then according to the three dimensions proposed in Urdapilleta *et al*. (2021).

Cronbach's alpha computation showed a reliability of $\alpha = 0.81$ with all items kept for wine professionals. The Cronbach's alpha for the three dimensions (involvement, knowledge, practices) were 0.82, 0.65 and 0.57, respectively. Concerning the consumers, Cronbach's alpha computation showed a reliability of $\alpha = 0.81$ with all items together. They were 0.85, 0.71 and 0.78 for the three dimensions. Given the lack of reliability of the dimensions, and the fact that the study did not aim to establish an adapted DO scale for NAS wine, the exploration of the items contributing the most to the different dimensions was not carried out.

Thus, a clustering approach for all items was preferred. An HCA (Euclidian distance and Ward criterion) with Kmeans consolidation was carried out on the raw data for both targets to cluster respondents with similar answers to the DO questionnaire. Three clusters were selected in consumers' and professionals' samples. Average scores were calculated over the two populations and clusters. Cronbach's alpha, ANOVAs and LSD tests were carried out by using XLSTAT V.2022.3.2 (Addinsoft, 2023) to compare each cluster. Sphinx IQ2 V.7.4.10 software (LeSphinx development, 2023) and chi-square tests were used to analyse clusters in relation to all sociodemographic and wine consumption/production/selling questions.

2.3.3. Comparative analysis

After the segmentation step for each panel, a Correspondence Analysis (CA) was performed on a contingency table containing the frequency of citation for each category and for each cluster of participants to compare the content of participants' mental representations of NAS wines. A value of 0 was attributed when a specific category was not used by a sub-group (Table 3). Only categorised words with a minimum of 5 % of citations were considered for the analysis. This analysis was performed using the free software R, version 4.3.2 (R Core Team, 2015).

RESULTS

1. Mental representations of NAS wines: consumers vs. professionals

1.1. Consumer panel

A total of 483 different terms and expressions were generated by the consumers. After the categorisation process, a total of 35 categories were produced. Figure 1 represents the prototypical analysis for categories with a minimum of 16 citations (5 %) representing 23 categories. Globally, the central core of the representation is composed of three main categories: natural, organic and healthy which is surrounded by good with a lesser level of importance and wine taste, no input and quality for the most important with a lesser number of citations. In general, all the categories were evaluated as positives by the consumer panel. The other categories with a lesser level of importance and level of citation are considered idiosyncratic.

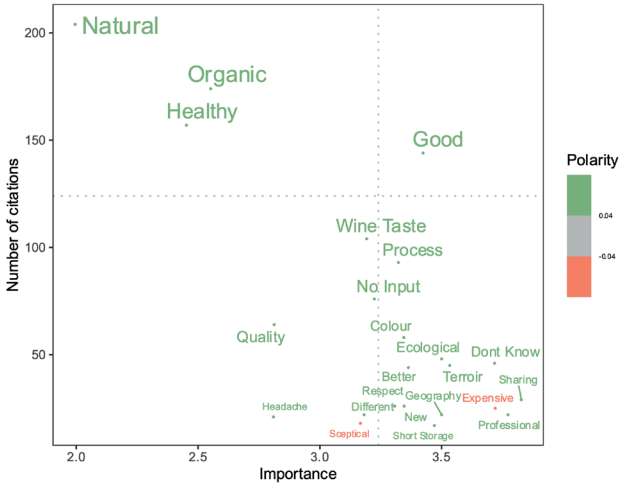


FIGURE 1. Prototypical analysis of the representation of NAS wine for the consumer panel (n = 319). The size of the terms is proportional to the number of citations, the colours correspond to the level of average connotation for each category: green for positive connotation, red for negative and grey for neutral.

To complete this first exploration of the hierarchical structure of the representation, Figure 2 presents the co-occurrence tree derived from the final categories of the consumer corpus. From the representation of NAS wines, the category natural (204 citations, Pi = 0.96) is a central node, connecting the categories organic (174 citations, Pi = 0.82) by 107 participants, and healthy (157 citations, Pi = 0.96) by 91 participants. From the organic node, categories evoking quality (64 citations, Pi = 0.97) and no input (76 citations, Pi = 0.78) are considered positive, and more important than colour, expensive, headache, geography, respect and new. In a way, it reflects the participants' representation of organic as qualitative and less-transformed products, that is linked to expensive for only nine consumers with a negative connotation. Only twenty-seven consumers expressed, through one or several terms, that they did not

know or were not able to produce more terms. This is mainly related to the participants who declared they did not know if they consumed NAS wines or not. From healthy node, ecological and sharing values were evoked, but with little frequency of citation, as the sizes of the nodes are small. With a lesser interconnexion, nine nodes are connected to natural categories such as good (144 citations), wine taste (104 citations), process (93 citations), terroir (45 citations), better (44 citations), different (22 citations), professional (22 citations), sceptical (18 citations) and short storage (17 citations) but are considered as less important than natural, and evaluated as positive with the exception of "sceptical", which is negative. Globally, the connotation attributed to all categories tends to be evaluated as positive, with only two categories with a negative connotation, which are part of the least important and least cited categories by consumers.

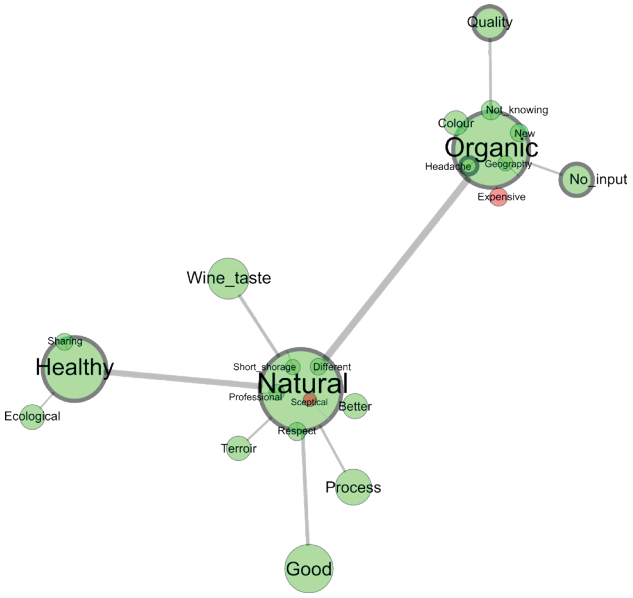


FIGURE 2. Graphical representation of consumers' mental representation of NAS wines derived from the co-occurrence analysis. The size of the terms and the nodes are proportional to the frequency, The colours correspond to the level of average connotation for each category: green for positive connotation, and red for negative. Categories with an average of importance below three are represented with a bold outline. The link between two terms corresponds to the co-occurrence between two terms: its thickness is proportional to this co-occurrence. Only categories with a minimum of sixteen citations are represented.

1.2. Professional panel

For professionals, a total of 1002 different terms and expressions were elicited, which were grouped into 48 categories. Only eight terms used once were non-categorised. Figure 3 represents the prototypical analysis for categories with a minimum of 27 citations (5 %) representing 26 categories. Generally, the central core of the representation is composed of a single category: defect, evaluated as negative. This category is surrounded by nature, risk, healthy, and short storage for the most important with a lesser number of citations. Unlike the consumer panel, there is a mix of categories evaluated either positively or negatively by the professional panel.

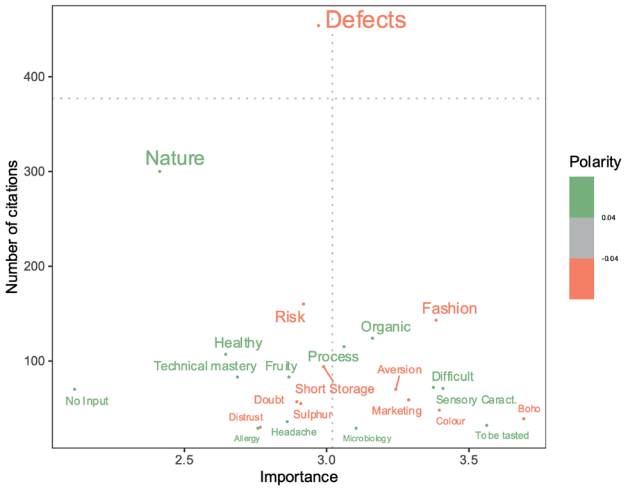


FIGURE 3. Prototypical analysis of the representation of NAS wine for the professional panel (n = 540). The size of the terms is proportional to the number of citations, the colours correspond to the level of average connotation for each category: green for positive connotation, red for negative, and grey for neutral.

Figure 4 shows that defects (454 citations) and nature (300 citations) represent two central and important nodes that emerged from the mental representation of NAS wines, with a very negative connotation (Pi = –0.96) for defects, and with a positive connotation (Pi = 0.45) for nature. These two categories were cited together by 150 participants, but nature terms are most often elicited before defect terms when we looked at the rank of appearance of the associated terms for each professional. From the defects node, five important categories emerged: risk (160 citations), doubt (57 citations), and distrust (30 citations) which are considered as negative, and fruity (83 citations) and technical mastery (83 citations) that are considered as positive. The other categories are ranked as less important with a mix between positive and negative evaluations. Among the most cited, fashion (143 citations), aversion (70 citations), and marketing (59 citations) are evaluated as negative while difficult (72 citations) and sensory characteristics (71 citations) are evaluated as positive. From the nature node, five important categories are linked: short storage (94 citations) and sulphur (55 citations) with a negative connotation; healthy (107 citations), no input (70 citations) and headache (36 citations) with a positive connotation. Concerning the least important categories from this node, organic (124 citations) and process (115 citations) are the most cited and evaluated as positive. In addition, healthy and organic were strongly linked to the nature category by respectively 60 and 83 participants. The other categories which were rarely linked to nature were globally less cited with positive connotations, which represent more idiosyncratic representations.

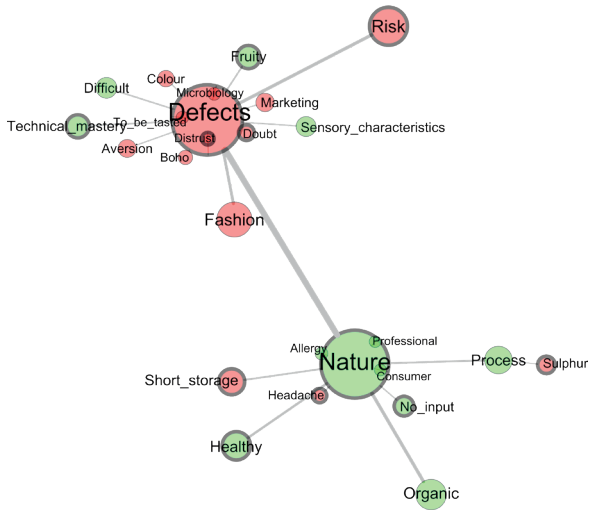


FIGURE 4. Graphical representation of professionals' mental representation of NAS wines derived from the co-occurrence analysis. The size of the terms and the nodes are proportional to the frequency, The colours correspond to the level of average connotation for each category: green for positive connotation, and red for negative. Categories with an average of importance below 3 are represented with a bold outline. The link between two terms corresponds to the co-occurrence between two terms: its thickness is proportional to this co-occurrence. Only categories with a minimum of twenty-seven citations are represented.

1.3. Effect of expertise and familiarity on mental representations of NAS wines

1.3.1. Segmentation of the panels through DO analysis

The 319 consumers and 540 professionals were grouped on both sides according to their answers to questions of familiarity. In both categories, three groups of participants were selected. Table 4 presents the average scores for each question.

For consumers, the three groups (C1, C2 and C3) are comprised of 45, 171 and 103 consumers, respectively. Variance analysis and mean comparison tests clearly show a gradient between the three groups. Group C1 has a significantly higher level of familiarity with NAS wines than groups C2 and C3. Group C3 itself has a level of familiarity with NAS wines significantly lower than group C2.

The crossing between its groups and socio-demographics is not significant (data not shown). There is no difference in the composition of the groups in terms of gender, age, PSC, or region of origin. Group C1 includes a greater proportion of regular consumers of wines, NAS, natural, and/or organic wines. Conversely, the C3 group has an overrepresentation of occasional consumers, non-consumers of NAS, natural and organic wines, and of those consumers who do not know if they consume this type of wine.

Professionals were also segmented into three groups (P1, P2 and P3) with 194, 149 and 197 people, respectively. Group P1

TABLE 4. Average scores of each DO question at both the panel and subgroup levels.

Type of panel	Consumer panel					Professional panel				
Level	All	C1	C2	C3	*p*-value	All	P1	P2	P3	*p*-value
Type of questions	319	45	171	103		540	194	149	197	
Involvement										
Q1	4.00	4.80 a	3.98 b	3.68 c	< 0.0001	2.80	3.41 a	3.23 b	1.87 c	< 0.0001
Q2	3.12	4.44 a	3.11 b	2.56 c	< 0.0001	1.63	2.01 a	1.74 b	1.18 c	< 0.0001
Q4	3.84	4.73 a	3.95 b	3.25 c	< 0.0001	3.06	3.82 a	3.40 b	2.06 c	< 0.0001
Q6	3.48	4.69 a	3.64 b	2.70 c	< 0.0001	2.51	3.39 a	2.56 b	1.61 c	< 0.0001
Q9	2.90	4.49 a	3.06 b	1.93 c	< 0.0001	2.17	2.95 a	1.70 b	1.77 b	< 0.0001
Q10	2.89	4.44 a	3.16 b	1.76 c	< 0.0001	4.14	4.48 a	3.54 c	4.27 b	< 0.0001
Knowledge										
Q11	2.93	4.60 a	3.15 b	1.84 c	< 0.0001	2.71	3.69 a	2.10 b	2.21 b	< 0.0001
Q12	2.88	3.76 a	3.19 b	1.98 c	< 0.0001	4.36	4.78 a	3.70 c	4.46 b	< 0.0001
Q13	2.52	2.67 a	2.58 ab	2.34 b	0.0753	2.86	3.39 a	3.00 b	2.223 c	< 0.0001
Q14	3.08	3.56 a	3.17 b	2.71 c	< 0.0001	3.47	4.10 a	2.86 c	3.32 b	< 0.0001
Q15	2.68	4.11 a	2.85 b	1.77 c	< 0.0001	-	-	-	-	-
Q16	2.55	4.02 a	2.87 b	1.39 c	< 0.0001	3.43	3.93 a	2.68 c	3.50 b	< 0.0001
Level of practices										
Q18	3.06	4.40 a	3.39 b	1.94 c	< 0.0001	-	-	-	-	-
Q19	2.47	4.13 a	2.69 b	1.39 c	< 0.0001	3.00	3.72 a	2.37 c	2.77 b	< 0.0001
Q20	2.45	4.02 a	2.57 b	1.56 c	< 0.0001	1.52	1.89 a	1.48 b	1.19 c	< 0.0001
Q21	2.50	4.24 a	2.68 b	1.44 c	< 0.0001	3.21	3.87 a	2.46 c	3.13 b	< 0.0001
Q22	2.74	3.22 a	2.77 b	2.50 b	0.0050	-	-	-	-	-
Average	2.95	4.14 a	3.11 b	2.16 c	< 0.0001	2.92	3.53 a	2.63 b	2.54 c	< 0.0001

contains professionals with greater familiarity and a positive perception than the other two groups with significantly higher averages for all questions. This group differs from the other two by a higher proportion of producers/wine sellers of NAS, natural and organic wines. There is an equivalent number of oenologists and non-oenologists in this group.

The P2 group has an overall average score (2.63) slightly higher than the P3 group. P2 is higher than P3 on questions Q1, Q2, Q4, Q6 and Q13. They seem to have a greater tendency towards NAS wines and a more positive perception. P3 is higher than P2 for questions that seem to be linked to wine skills such as "Q10 - *I know how to recognise a good no added sulphite wine from a poor one*" or "Q12 - *I know nothing about no added sulphite wine*", "Q16 - *I have better knowledge about no added sulphite wines compared to other people*" and other questions Q14, Q19, Q21. It could be explained since group P2 contains a larger proportion of non-producer/wine prescribers and a significantly lower proportion of oenologists. In addition, there is a slight overrepresentation of women in this P2 group.

1.3.2. Mental representations of NAS wines for consumers' and professionals' subgroups according to their level of familiarity

Figure 5 shows the projection of the categories used by each subgroup within the two panels. Dimension 1 explains 83.99 % and shows a divergence between consumer and professional subgroups. From familiar (C1) to less or unfamiliar subgroups of consumers (C2 and C3) with NAS wines, Figure 5 shows a slight change in the content of their respective mental representations. Unlike the consumer panel, the content of the professionals' mental representations seems to be more affected by the level of familiarity with NAS wines: Dimension 2 (8.92 %) opposes the most familiar groups P1 and P2 to the least one P3.

When looking at the co-occurrence trees for each subgroup of professionals (Figure 6A–C), we observe that the most familiar group P1 has a more positive representation focused mostly on the nature node while the less familiar group P3 has a more negative representation focused on defects. In addition, the categories of terms that are linked to the nature node for P1 are healthy, fruity, process, and no input for the most cited and important, and are fashion, risk, short storage, and aversion for P3 around the defects node. Finally, the professional participants used the same categories of terms in link with the NAS-induced word, but these terms are evaluated differently in terms of consideration and importance. Only the category risk is similarly quoted and evaluated by all professional subgroups. Thus, this graphical representation enables us to provide more information on the co-appearance of words within the categories per subgroup to complete the CA (Figure 5) which maximises the differences between the sub-groups of participants.

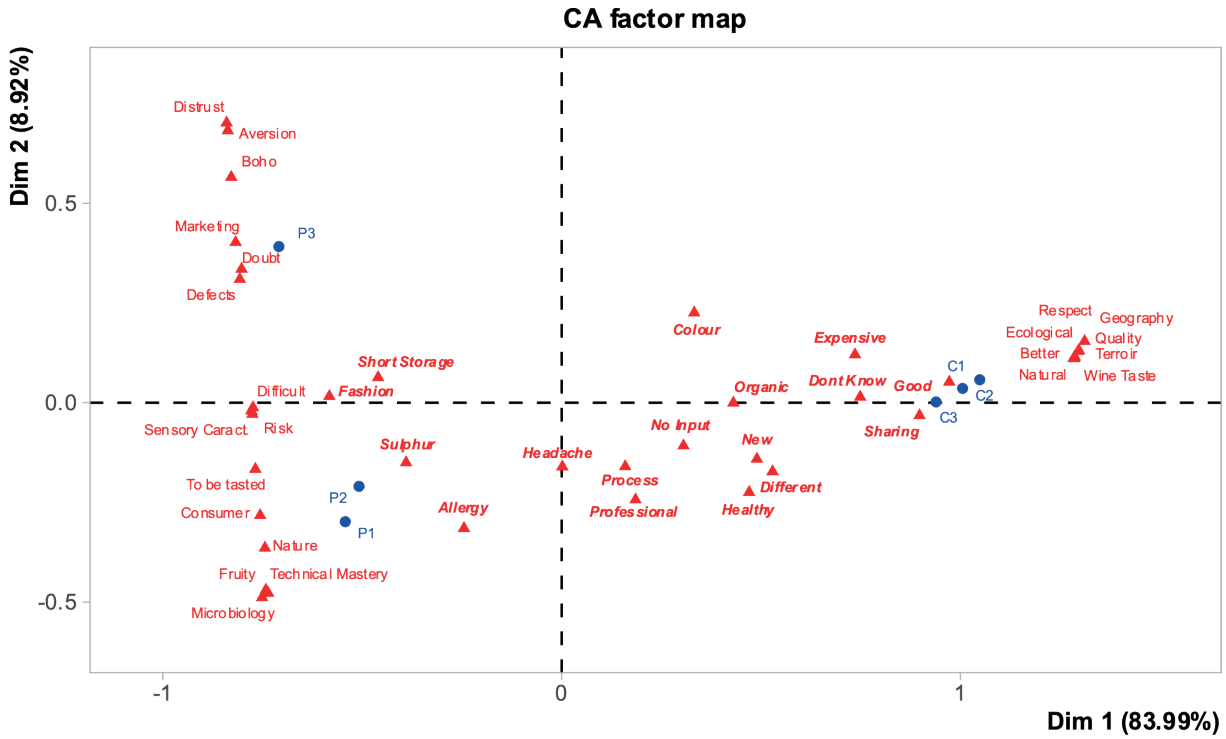


FIGURE 5. Comparison of the sub-groups of participants from the correspondence analysis performed on the frequency of the categories mentioned by at least 5 % of the participants. C1: more familiar consumers, C2: intermediate consumers, C3: less familiar consumers, P1: more familiar professionals, P2: intermediate professionals, P3: less familiar professionals. Common categories between the two panels are represented in italics.

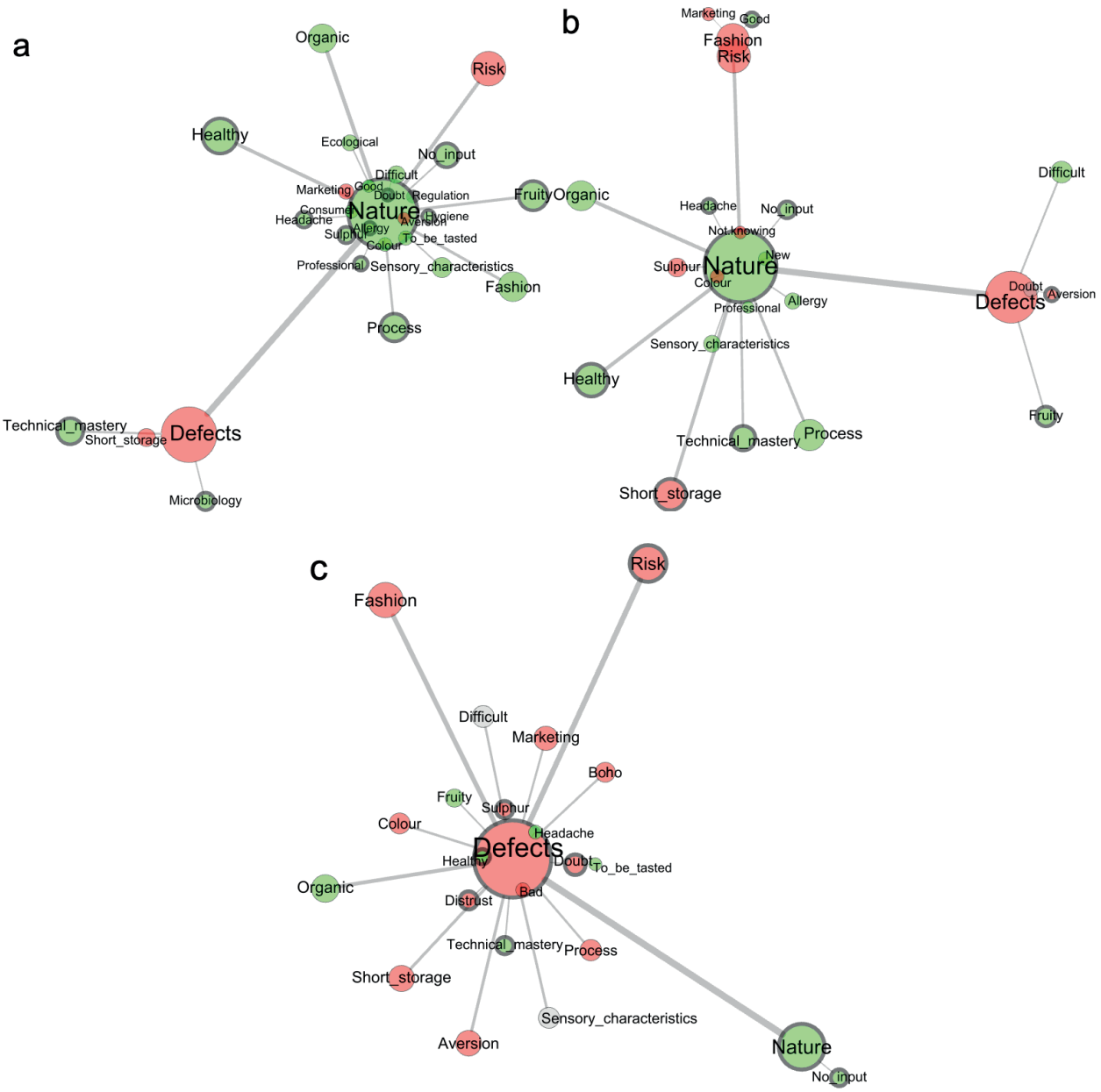


FIGURE 6. Graphical representation of the results from co-occurrence analysis of a) more familiar (P1, n = 194), b) intermediate (P2, n = 149), and c) less familiar professionals (P3, n = 197) with NAS wines. The size of the terms and the nodes are proportional to the frequency, The colours correspond to the level of average connotation for each category: green for positive connotation, red for negative, and grey for neutral connotation. Categories with an average of importance below three are represented with a bold outline. The link between two terms corresponds to the co-occurrence between two terms: its thickness is proportional to this co-occurrence.

DISCUSSION

1. Less is more "natural" or "sustainable": toward a no added or chemophobia attitude?

Contrary to our hypothesis, results showed that consumer participants have a positive representation of NAS wines, whatever their level of familiarity with those wines. Their mental representation is focused on three main categories of terms: natural, organic, and healthy, which are also retrieved from a recent qualitative survey with Italian consumers who specifically asked about natural wines (Fabbrizzi *et al*., 2021), and past studies on NAS or natural wines with French wine consumers (Honoré-Chedozeau *et al*., 2022; Symoneaux, 2020; Urdapilleta *et al*., 2021). Yet, this triad of words clearly echoes the perception of natural-based products, or even "natural" wine, that remains unclear for consumers (Alonso González & Parga-Dans, 2020). As pointed out by Asioli *et al*. (2017) in their review, the word "natural" evokes a positive association with "natural" products, linked to taste, health and environmental concerns. In our results, environmental concerns are also evoked through

the Ecological category but only by a few consumers (48 citations). On another note, when asking French and Italian wine consumers about sustainability among conventional, organic, biodynamic, NAS, natural, fair-trade and carbon-neutral wines, Capitello and Sirieix (2019) showed that NAS wines are perceived differently from the other wines. Indeed, NAS wines were positively associated with health benefits (*i.e*., no headaches and good for health), but negatively associated with ethical and environmental ones by both French and Italian respondents. Only French consumers described NAS wines as having a distinctive taste. This exclusion of NAS wines was also recently addressed by Maykish *et al*. (2021) who associate NAS wines with clean wines, as recently trademarked in California and the United States. They explained this distinction between NAS and natural wines by different winemakers' objectives: the NAS producers aimed to decrease the use of additives for health reasons while the natural wine producers aimed to intervene less during winemaking and to use native yeast for philosophical reasons. However, this distinction remains unclear in European wine-producing countries due to the lack of clarity and specific regulations and definitions for natural and NAS wines (Alonso González & Parga-Dans, 2020; Alonso González & Parga-Dans, 2023; Galati *et al*., 2019; Jones & Grandjean, 2018). In addition, the third-word organic presents in the triad of words used by consumers reinforces this association of NAS wines with health concerns. In fact, Kim and Bonn (2015) showed that Americans consumed organic wines for health concerns. D'Amico *et al*. (2016) showed also that Italian wine consumers associated organic wine with a natural perception and designation of origin that led them to be willing to pay more if no sulphites were added.

In any case, the "no added" mention certainly contributes to the positive image by announcing the avoidance of a chemical product in the winemaking process that is perceived as risky, unhealthy and unnatural by consumers (Costanigro *et al*., 2014; Staub *et al*., 2020). Asioli *et al*. (2017) who reviewed 16 papers from nine different countries for "free from" food products highlighted that consumers have globally a negative perception of additives mainly due to anxiety associated with the health risks. This anxiety seems to be driven by media and relatives, the lower level of knowledge, awareness, familiarity with a food additive, the origin (*i.e*., artificial additives are considered as unhealthy) and the type of additive. In addition, results showed that women seem to be more sensitive to chemical exposure, and older more sensitive to food safety, leading to avoidance of products containing additives and so on, a more positive attitude towards "free-from" food products. In this review, these factors seemed to be different from those for organic and natural food products by being more concrete, findable, and understandable for consumers which could explain this distinctive consumer perception compared to the other wine categories. From this perspective of rejecting artificial additives, Nieto-Villegas *et al*. (2023) recently addressed that question around the concept of chemophobia based on the neophobia principle, by specifically studying NAS wines through an online questionnaire with Spanish consumers. The main results showed that the 'no added sulphite' label is considered with great importance and that consumers with lower education are more chemophobic than others. This wine chemophobia appeared to be distinctive of both wine neophobia and food chemophobia for which chemical compounds in food seem to be more unknown than wine. That difference could be explained by Olsen *et al*. (2007)'s results showing that young American wine consumers considered wines as the least harmful alcoholic drink for health. Moreover, this concern among young consumers is far from being the only one. Indeed, Bernabéu *et al*. (2008), Simeone *et al*. (2023) and Sogari *et al*. (2016) demonstrated that Italian and Spanish young consumers are more sensitive towards wine with sustainable characteristics. This result is also retrieved in the recent study from Ugalde *et al*. (2022) showing that young French wine consumers are more concerned by both environment and health, including NAS wines. In addition to age, levels of both education and involvement in wine seemed to play a role in organic or NAS wine acceptability (Capitello & Sirieix, 2019; Maesano *et al*., 2021; Saltman *et al*., 2015; Staub *et al*., 2020). Through an online survey, Saltman *et al*. (2015) showed that Australian wine consumers with a high level of wine knowledge are more willing to accept conventional additives used in the winemaking process, including sulphites than consumers with a lower level of wine knowledge.

From all these results, organic, biodynamic, natural and NAS wines ultimately seemed to be perceived as more similar than different in consumers' minds. This fact could be due to a certain confusion caused by consumers facing the lack of regulations, definitions, clarity and agreement between wine-producing countries for those wine categories, whether in Europe or internationally (Alonso González *et al*., 2022; Alonso González & Parga-Dans, 2020; Alonso González & Parga-Dans, 2023). However, the different sustainable, health and non-additive concerns seem to overlap differently in consumer's minds according to their age, level of anxiety facing chemical compounds, and their level of involvement with wine. In addition, D'Amico *et al*. (2016) showed that the effect of information given to NAS is crucial because if inappropriate, this discourages Italian consumers from paying more for it, while European wine consumers are willing to pay more for it (Amato *et al*., 2017; Deneulin & Dupraz, 2018; Raineau *et al*., 2023). Finally, the trends identified in the studies on these specific characteristics of consumers who are more sensitive to health, environment and additives raise questions about NAS wine consumers in relation to consistent representations whatever the level of familiarity with NAS wines, age, gender, or type of jobs: are there typologies of French consumers who are particularly sensitive and/or exclusive to NAS wines?

2. NAS wines with defects: an actual heated debate among French wine professionals

Our results showed that there is a contrast between consumer and professional representations of NAS wines. The very negative representation focused on defects at an expert panel level is probably due to the high proportion of wine

producers that responded to our study, including 48.7 % of oenologists. Only 10.6 % are wine sellers, and 25.4 % with another wine job. Indeed, recent work on the influence of different types of wine experts on mental representations and perceptions highlighted the fact that winemakers have a more negative attitude, always focused on the presence or absence of any defects in their quest for quality in wines (Honoré-Chedozeau *et al*., 2024; Otheguy *et al*., 2021; Otheguy *et al*., 2023), while sellers and critics have a more positive attitude in the way they express their tasting experience to consumers, in a more idiosyncratic style for wine critics. This effect is not only influenced by the type of expertise but also by the level of familiarity with NAS wines. As demonstrated by Honoré-Chedozeau *et al*. (2017), both expertise and familiarity seem to have an impact on the mental representation of wines in terms of structuration, flexibility of thought, and content that could explain the difference found between experts, according to their level of exposure and practices to NAS wines. In other words, those who make, sell, or recommend NAS wines have a more positive representation based on "nature" that seems to refer to the category of the product instead of the natural-based description by the consumer panel. Indeed, the elicited terms of this category expressed a direct link with the wine or referred to the French labelling "vin méthode nature" proposed by the French association of natural wine producers.

In their representations, consumers did not at any time mention the word 'defects' or other terms approaching this. The notion of 'defect' is clearly a component of wine expertise, and an obsession of winemakers, for which consumers seem to have little or no knowledge at all. The question would be whether they can detect the defects in wine as identified by wine professionals, and thus determine their degree of acceptance or rejection of wine defects. Recently, Franco-Luesma *et al*. (2019) tried to answer this question of the oxidation defect by spiking two commercial red and white wines with acetaldehyde, phenylacetaldehyde and methional compounds at different levels of concentration, to create a chemical oxidative gradient. A panel of 29 wine professionals and 32 wine consumers were recruited to only smell two series of 12 glasses and to determine whether they would serve each glass of wine to their friends before dinner. Results demonstrated minor differences in the acceptance/rejection of the oxidised wines between professionals and consumers but highlighted five different behaviours in that categorisation of oxidised wines for both panels. Unsurprisingly, consumers used negative hedonic terms to describe oxidised wines while professionals used oxidation-related terms. The low consensus between professionals and the different levels of acceptance and rejection between consumers demonstrated that the perception of defects in wines is a real debate, for both wine professionals and consumers. Other defects like *Brettanomyces* and mousy characters are also part of it from a sensorial perspective (Tempere *et al*., 2017; Tempère *et al*., 2019). Recently, by comparing natural versus conventional Spanish white wines, Sáenz-Navajas *et al*. (2023) showed that 70 % of the natural wines (*i.e*., following French vin méthode nature regulations) were described by Spanish wine professionals with defects or non-positive attributes like vinegar, oxidation, evolved, and animal. As these defects are the most cited in the representations of professionals for NAS wines, it seems necessary to evaluate the degree of acceptance and rejection within different sets of NAS wines with both wine professionals and consumers during future tastings. Given the discrepancy between representations of professionals and consumers for NAS wines, it would also be interesting to compare an informed with a non-informed condition, to determine what impact the NAS information might have on wine tasting. In fact, Symoneaux (2020) showed that the wines were more appreciated by French wine consumers when the NAS mention was indicated on the label during the wine tasting. From the professional side, Otheguy *et al*. (2023) demonstrated that providing information on Beaujolais and Beaujolais Pierres Dorées PDO wines during a wine tasting enabled them to better discriminate the wines between PDOs and those without the information. This information also had an impact on the descriptors used, which referred more to quality descriptors for Beaujolais Pierres Dorées than for Beaujolais wines, in accordance with the qualitative expectation of professionals for these wines. Considering their negative representations focused on defects for NAS wines, we could imagine that this information leads them to look for defects in wines more than they would without this information.

CONCLUSION

This first exploration study about the emergent phenomenon of NAS wines in France has enabled us to highlight a gap that exists between supply and demand. This new range of product is complex, due to several reasons and questions that arise. Firstly, the market is ill-defined with too many different claims and the existence of two types of NAS wines in France (those labelled as "vin méthode nature" and the others that can be associated with any category of wine like conventional, organic, and biodynamic). It remains to be seen to what extent this category contributes to the perception of natural or "natural wine" for consumers, independently of its certification.

Secondly, results about the mental representation of wine professionals for NAS wines highlighted that they have different perceptions of what a NAS wine is or should be. In fact, they often disagree about the NAS winemaking process and quality judgments for those wines when a defect is perceived. It seems that a confrontation remains, depending on the level of interventionism of professionals in the winemaking process, but also in the definition of what a defect means or how it should be considered by consumers that appreciate and/or accept the presence of oxidation or *Brettanomyces* character in wine for instance. The question is to what extent can this way of thinking affect the perceived quality of wines?

Lastly, from the consumer side, the proportion of consumers claiming to consume NAS wines through this study is rather

low. Therefore, it would be interesting to determine the extent to which NAS wines are a niche market, and what consumers expect regarding a natural process in the wine field, but more generally for food and beverage products. Even if wine has a particular status—traditional, social, economic or historical—and is an exception in the food and beverage field, what do consumers expect?

Considering these issues, this study on the content and the structure of mental representations of NAS wines remains a first approach. It seems more than necessary to go further and ask consumers directly about their expectations and questions about so-called natural wines, but also all the different wine categories claiming healthy and/or environmental benefits. Information on these wines, conveyed by labels through logos, certifications, eco-labels, or claims, still varies widely within and between countries and seems to be poorly understood by consumers. The main challenge for research would seem to focus on ways of making this information clearer, more transparent, and easier for everyone to understand, whatever the level of involvement in wine or health awareness. In addition, it would also be helpful if wine-producing countries could adopt a clear position towards wines claiming to be natural and/or sustainable to make the market less complex and more transparent and understandable for all consumers around the world.

ACKNOWLEDGEMENTS

This study is part of the financing of the CASDAR "Vins Sans Sulfites" project led by the French Institute of Vine and Wine. The French Ministry of Agriculture cannot be held responsible. The authors express their thanks to Nolwen Audrain, Victoria Lelan, Clara Desfontaines, Jean Talbot and Thibaut Dubois from Ecole Supérieure des Agricultures for their help in the data collection. They also thank all the partners who distributed the questionnaires to their members by mail or newsletter: Institut Français de la Vigne et du Vin, Union des OEnologues de France, Interloire, InterBeaujolais, Conseil Interprofessionnel des Vins de Provence, Conseil Interprofessionnel des Vins d'Alsace, Bureau Interprofessionnel des Vins de Bourgogne, Comité Interprofessionnel des Vins de Champagne, Conseil Interprofessionnel des Vins du Languedoc, Association interprofessionnelle Sudvinbio, Fédération Régionale D'agriculture Biologique Nouvelle-Aquitaine, InterRhône, Institut Rhodanien, Alliance Loire, and all the professionals that answered the questionnaire.

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