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Product categorization of Korean rice wine (*makgeolli*) compared to beer and wine using sensory evaluation methods

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Abstract

This study aims to investigate the product categorization and characterization of *makgeolli* (Korean rice wine [KRW]) among beer and wine samples. Projective mapping with ultra-flash profiling (PM with UFP) ($n = 68$) was conducted with 12 alcoholic beverage samples, including wines, beers, and *makgeolli*, and showed that participants characterized wine based on fruitiness, beer on bitterness, and *makgeolli* on sourness. s showed that PM with UFP had a combined explained variance of 47.4% with beer, wine, and *makgeolli* grouped separately. However, when participants were separated based on wine knowledge, low wine knowledge participants placed Shiraz close to *makgeolli* indicating participants were using a different metric in grouping the alcoholic beverage samples. When participants were tasked with using polarized sensory positioning ($n = 91$) to characterize *makgeolli* and wines, participants regardless of wine knowledge showed that wine and *makgeolli* had unique sensory traits and thus should be categorized differently.

Practical Applications

Research on KRW (*makgeolli*) is relatively limited in Western societies and this study attempts to understand how participants categorize *makgeolli* in New Zealand among different alcoholic beverages using projective and characterizing methods. Based on the categorization theory, it is important to position the product properly in the food and beverage categories as consumers may use the category cues to evaluate *makgeolli* and use products such as beer or wine within the same category as price anchors for *makgeolli*'s price in the market. The results showed that participants categorize *makgeolli* differently compared to wine and beer; therefore, it would be beneficial to position *makgeolli* separately. Practical applications may include creating a separate section on a restaurant beverage menu, a webpage on an alcoholic beverage seller's website, or a small sub-section on the retail store shelf. Placing *makgeolli* in the wine section as previously suggested is not recommended.

1 | INTRODUCTION

Market positioning determines the direction of the overall marketing strategy of promoting, pricing, and communicating products to consumers (Aaker & Shansby, 1982). Currently, *makgeolli* (Korean rice wine [KRW]) is a novel product within the Western market due to its low availability and awareness in the alcoholic beverage market. A few studies have looked into the sensory and consumer acceptance of KRW including Kwak et al. (2015), Wong, Muchangi, et al. (2023), and Wong, Owens, et al. (2023) with Western consumers and participants. KRW acceptance was positively correlated with fruity characteristics and was negatively affected by a yeasty and bitter taste among American consumers. Other research conducted on KRW using sensory methods in the English scientific literature, include Check-All-That-Apply, Just-About-Right (Lee et al., 2021; Wong, Owens, et al., 2023), consumer testing (Jung et al., 2014), and projective polarized mapping (Wong, Muchangi, et al., 2023).

A key research gap for *makgeolli* is product categorization within the alcoholic beverage market and to identify which marketing strategy, such as product differentiation or subtype strategy, is most suitable within Western markets such as New Zealand. This paper sets out to use sensory methods such as projective mapping (PM) and polarized sensory positioning (PSP) to understand how participants categorize and characterize *makgeolli* on perceptual maps. PM (also known as Napping®) often coupled with ultra-flash profiling (UFP) is a holistic approach to product profiling. All samples of interest are presented simultaneously to the participants who are instructed to group samples according to their similarities and differences. Participants are asked to group samples according to their criteria and not restricted to grouping products by one sensory modality such as sight, taste, texture, and smell; in addition, more complex instructions can be included such as using red light to reduce visibility. Distances are then analyzed to identify the different clusters of food samples or consumer groups and identify reasons for their arrangement based on their product similarities (Valentin et al., 2018).

PSP is a reference-based method where specific sensory characteristics are predetermined and samples are rated against the similarities of a set of references called poles (Teillet, 2015a, 2015b). This technique was originally created by Teillet et al. (2010) to understand the flavor attributes of water and was later used to analyze other food products such as wine (Wilson et al., 2018) and fruit-flavored drinks (Saldamando et al., 2015).

Categorization plays a vital role in product positioning, according to categorization theory, people naturally divide the world of objects such as consumer products for ease of information processing and is a fundamental learning process in psychology, where people identify the overlapping similarities of objects, and maximize the differences between groups (Mervis & Rosch, 1981). Categorization theory can also be used in new product development, where researchers and producers can identify potential gaps in the current market and introduce new products using either product differentiation or subtype strategy (Sujan & Bettman, 1989). According to the literature, categorization is a natural process that consumers undergo to understand and familiarize themselves with new products (Durand & Khaire, 2017; Gregan-Paxton et al., 2002; Ozanne et al., 1992). Researchers such as Goode et al. (2013) showed that new products placed in a category that is mismatched from consumer expectations would be underappreciated and ultimately fail within the marketplace, while Kuijken et al. (2017) demonstrated that consumers use category cues for average price referencing for new products.

When new products share noticeable similar attributes in the market, then using the product differentiation strategy would be beneficial as this highlights superior features of the new product to consumers; creating a competitive advantage for the producer (Sujan & Bettman, 1989). Product differentiation allows the producer to enter their brands into other product markets (e.g., brand extension). When the new products' attributes are perceived to be different from other products within the category, a subtype strategy would be more beneficial as it creates new boundaries for the new product which disassociates itself from other products currently in the market (Sujan & Bettman, 1989).

This study aims to use sensory evaluation to understand how New Zealand participants categorize and characterize *makgeolli* compared to other alcoholic beverages such as beer and wine. As both beer and wine have traditionally been consumed in New Zealand, identifying whether *makgeolli* fits in either alcoholic beverage category can determine what type of marketing strategy could be used. For example, due to New Zealand's cultural ties with the United Kingdom, beer was considered as New Zealand's national beverage (Golledge, 1963). As a sense of consumer identity, beer was often associated with masculinity or a rural male image (Campbell, 2000; Law, 1997). However, in the past 30 years, New Zealand's identity of consuming beer somewhat changed with the introduction of craft beer (Murray & Overton, 2016), female-led beer brewers (Kuehn & Parker, 2021), and the development of the wine industry (Wilson & Goddard, 2004). Both beer and wine products were included in this study because both alcoholic beverages are the most popular alcoholic variety in New Zealand. In addition, the choice of specialty beer provides a greater sensorial range. Specialty beer (also known as craft beer) has been extensively researched in New Zealand for their sensory properties in research articles written by Jaeger et al. (2017); Jaeger et al. (2020); Jaeger et al. (2019). Therefore, the authors deemed specialty beer more appropriate for this study as regular beer tends to be homogenous in flavor and taste. In terms of wine, New Zealand has been known for wine production and are regular consumers of wine products (Jaeger et al., 2009; Mouret et al., 2013; Parr et al., 2007; Thomas & Pickering, 2003). Four wines were chosen for the different sensory properties including Sauvignon Blanc (white wine), Chardonnay (white wine), Rosé, and Shiraz (red wine). Sauvignon Blanc was chosen due to its "green" characteristics (alternatively known as capsicum or vegetable flavor attributes) (Green et al., 2011; Parr et al., 2007), while Chardonnay has fruity and floral flavor attributes (Kustos et al., 2020; Lucas et al., 2023). Rosé was chosen due to its unique sensory properties of encapsulating both red wine and white wine properties (Ballester et al., 2009; Wang & Spence, 2019). Finally, Shiraz was chosen due to its full-bodied and spice (e.g., peppery) characteristics (Johnson et al., 2013; Kustos et al., 2020).

This information is important because it aids producers and researchers in correctly identifying the market position of rice wine (specifically *makgeolli*) in New Zealand. This study was carried out in two parts with PM with UFP being implemented first, followed by PSP. By completing both PM with UFP and PSP experiments, the results should provide greater insight into the potential ways of marketing *makgeolli* in the New Zealand beverage market.

2 | MATERIALS AND PROCEDURE

The following section is a description of the methods and procedures of PM with UFP and PSP experiments carried out in this research study. The specific tests and methods in the two sensory evaluation experiments will be discussed in Section 2.3.1 for PM with UFP and Section 2.3.2 for PSP.

2.1 | Alcoholic beverages for sensory analysis

2.1.1 | *Makgeolli* samples and processing methods

From the literature, there are multiple methods of producing *makgeolli*. However, the four *makgeolli* samples used in this study were identified by Wong, Muchangi, et al. (2023) and will be referred to as 1SF-N, 1SF-YN, 2SF, and 3SF in this study. Based on Wong, Muchangi, et al.'s (2023) naming convention of the *makgeolli* samples, the number code on the *makgeolli* sample refers to fermentation stages, and the right hyphenated part of the *makgeolli* name refers to the culture used for fermentation. All *makgeolli* samples were prepared in the Food Science Laboratory of Auckland University of Technology (Auckland, New Zealand) and all materials were acquired from the Auckland CBD area.

Single-stage fermented *makgeolli* with *nuruk* (1SF-N) involved washing 2 kg of glutinous rice (Wang Ltd., Korea) with deionized (DI) water until the water ran clear (around 10 min of continuous washing). The washed glutinous rice was then soaked for 3 h before being drained for 1 h. The glutinous rice is then steamed for 120 min and then cooled to 25°C, followed by mixing 3 L of DI water and 500 g of crushed *nuruk* (Wang Ltd., Korea). The rice mixture was then fermented at 25°C for 7 days. 1SF-N was then filtered and stored in an amber-colored bottle at 4°C refrigerator until it was used for either PM or PSP (all *makgeolli* samples were consumed within a week).

Single-stage fermented *makgeolli* with yeast and *nuruk* (1SF-YN) was produced in a similar procedure as 1SF-N; however, 40 g of ground *nuruk* and 11 g of dry yeast (Safale US-05 dry ale yeast, Fermentis, S.I. Lesaffre, France) were used instead of 500 g of *nuruk* for fermentation.

Two-stage fermented *makgeolli* (2SF) differs from 1SF-N and 1SF-YN samples where the fermentation time is longer, and a fermentation base was first produced before being incorporated in the glutinous rice and DI water mixture. The fermentation base was produced by first washing 400 g of non-glutinous (Wang Ltd., Korea) with DI water. Once the DI water ran clear (around 10 min of continuous washing), the non-glutinous rice was soaked for 3 h and then drained for 1 h. The non-glutinous rice is then pulverized into smaller particles using a blender (Russell Hobbs, UK). The non-glutinous rice powder is cooked for 15 min with 1.25 L of DI water and then cooled to 25°C before combining 200 g of ground *nuruk*. The fermentation base is then left to ferment for 1 day at 25°C. The rice mash consisting of the non-glutinous rice and *nuruk* was filtered and 1 L of the fermentation base was incorporated into the 2 kg of glutinous rice with 1.5 L of DI water; the following steps were similar to what was described for 1SF-N and left to ferment for 7 days at 25°C.

Three-stage fermented *makgeolli* (3SF) followed the same procedure as 2SF; however, the preparation of the fermentation base was longer, and the fermentation base was fermented two times. After 1 day of fermentation, the rice mash was filtered from the first fermentation base, and 1 L of the fermentation base was incorporated into another set of 400 g of washed, drained, pulverized, and cooked non-glutinous rice. No additional *nuruk* was incorporated into the second fermentation base and it was fermented for 1 day at 25°C. The second fermentation base was incorporated into steamed glutinous rice and followed the same procedure as 2SF.

2.1.2 | Samples used in PM with UFP

Twelve samples of alcoholic beverages were used for the PM with an ultra-flash profiling (UFP) experiment. Four beers (Pilsner, Pale ale, Porter, and IPA), four wines (Shiraz, Chardonnay, Rosé, and Sauvignon Blanc), and four *makgeollis*, as shown in Table 1 with the brand name, alcoholic type, alcohol content/percentage, and origin of production. Beer was also included in the PM with UFP experiment because the processes of producing rice wine are similar to beer. For example, the yeast strain required for rice wine fermentation closely resembles beer rather than wine (Legras et al., 2007), and the predominant sugar source for fermentation is cereal. All beers and wines were purchased from a New Zealand local supermarket (Countdown, New Zealand) in the Auckland CBD area, while *makgeolli* was produced in the Auckland University of Technology Laboratory. About 15 mL of the sample was pipetted in a 30-mL transparent portion cup with a lid and was presented in two rows, with six samples in each row. All samples were presented simultaneously with three randomized digit numbers in randomized order to reduce the sample placement effect. Participants were aware of the different types of alcoholic beverages that they were consuming from the information sheet; however, the researcher did not specify or identify the corresponding alcoholic beverage to the three randomized digit numbers on the 30 mL transparent portion cup until the participants ended their PM with UFP experiment.

2.1.3 | Samples used in PSP

The PSP is more directive, and the method requires participants to compare *makgeolli* and the alcoholic products to specific reference samples also known as "poles." The selection of poles provides a reference point for participants to compare the similarities and differences of the product being tested (Ares et al., 2018). From the PM with UFP experiment, there was evidence that participants tend to group *makgeolli*, wine, and beer differently. However, when participants were divided into different cluster groups, Shiraz was positioned closely to *makgeolli* (see Supporting Information SI.1 for the multiple factor analysis (MFA) maps for the four different cluster groups).

In terms of the pole selection for PSP, Teillet et al. (2010) and Ares et al. (2015) did not specify the criteria needed to be fulfilled for the experiment to be conducted; however, three poles were

TABLE 1 Summary table of the alcoholic beverages used during the projective mapping with ultra-flash profiling (PM with UFP) ($n = 12$) and polarized sensory positioning (PSP) ($n = 9$) experiment consisting of beer, wines, and *makgeolli* samples.

Present during experiment	Name of sample	Alcoholic type	Brand/product name	Country of origin	Alcohol content[a] (% ABV)
Both PM and PSP	Shiraz	Wine	Yalumba Premium	Australia	13.0
Both PM and PSP	Chardonnay	Wine	Yalumba Winesmiths	Australia	13.0
Both PM and PSP	Rose	wine	Yalumba Winesmiths	Australia	12.5
Both PM and PSP	Sauvignon Blanc	Wine	Yalumba Winesmiths	Australia	10.5
Both PM and PSP	1SF-YN	KRW[b]	N/A[c]	New Zealand	4.5
Both PM and PSP	1SF-N	KRW[b]	N/A[c]	New Zealand	13.0
Both PM and PSP	2SF	KRW[b]	N/A[c]	New Zealand	7.8
Both PM and PSP	3SF	KRW[b]	N/A[c]	New Zealand	12.6
PM only	Pilsner	Beer	Mac's Pilsner Miss Conduct	New Zealand	5.2
PM only	Pale Ale	Beer	Mac's Craft Beer Three Wolves	New Zealand	5.1
PM only	Porter	Beer	Mac's Beer Black	New Zealand	4.8
PM only	IPA	Beer	Mac's Pale Ale Green Beret	New Zealand	5.4
PSP only	Cabernet Sauvignon	Wine	Yalumba Winesmiths	Australia	13.0

[a]Alcohol content expressed in percentage alcohol by volume information was provided by either product package or laboratory results from the previously published article (Wong, Muchangi, et al., 2023).
[b]KRW is the abbreviation for Korean rice wine (*makgeolli*).
[c]Korean rice wine (*makgeolli*) was produced in the university laboratory; therefore, brand name is not applicable to this section.

suggested as the optimal number of references to allow researchers to produce a representative perceptual map using multidimensional scaling or MFA. Teillet (2015a, 2015b) noted it would be advantageous for the researcher to include "poles" that encompass the sensory aspects of all the samples, therefore Chardonnay, Shiraz, and 1SF-N were selected as the three poles for the PSP experiment.

About 15 mL of the nine wine and *makgeolli* samples was pipetted in 30 mL transparent portion cups with a lid and were presented in two rows, the first row with five samples and four in the second row. All samples were presented with three randomized digits and the placement of the nine samples was randomized. And 40 mL of Chardonnay, Shiraz, and 1SF-N was prepared in a 100-mL portion cup with a lid labeled R1, R2, and R3, respectively, as poles which the participants can refer to throughout the PSP experiment as the three reference points.

2.2 | General information of participants

Participants were screened for the following criteria: (1) the participant does not suffer from food allergies such as wheat, rice, and alcohol, (2) the participant is not pregnant or trying to conceive a child, (3) not operating heavy machinery or driving within 2 h after completing the sensory test and (4) be or over the legal age of 18 were allowed to take part in the sensory study (the legal age of consuming alcohol in New Zealand). Both PM with UFP and PSP were reviewed and approved by the AUT Ethics Committee 19/241.

Participants were required to review the information sheet and to give written consent to the researchers before the experiments took place. Measures of age, ethnicity, frequency of alcoholic beverage consumption, objective wine knowledge, and subjective wine knowledge information were also collected. The objective and subjective wine knowledge questions were used to examine the participant's degree of knowledge, attitude, and behavior toward wine (Ellis & Caruana, 2018; Flynn & Goldsmith, 1999; Forbes et al., 2008). Objective wine knowledge is often referred to the knowledge that consumers does actually know, shows that consumers are able to correctly answer questions regarding the topic of wine. In comparison, subjective wine knowledge is a self-assumed knowledge in which the consumers think they know about wine (Forbes et al., 2008). It is important to note that objective and subjective wine knowledge scale is designed for wine consumers. From other researchers regarding product categorization, it was important to measure the participant's experience in the form of subjective and objective knowledge (Chocarro et al., 2009) and Kwak et al. (2015) stated that American consumers perceived KRW to be in a similar category with white and semi-sweet white wine. The purpose of objective and subjective wine knowledge questions was used as an exploratory tool to see whether different group clustering exists among the participants (Wong, Owens, et al., 2023) and whether this would affect the categorization *makgeolli* in PM with UFP and PSP experiments. In terms of the wine knowledge assessments used in both PM with UFP and PSP experiments, objective wine knowledge questions were taken verbatim from Forbes et al. (2008) and Ellis and Caruana (2018). The five objective wine knowledge questions are included below with bold writing as the correct answer: "Which of the following is a red wine?" Riesling, Chardonnay, **Merlot**, Sauvignon Blanc, and I don't know; "A peppery character is most associated with which wine?" Merlot, **Shiraz/Syrah**, Semillion, Pinot Noir, I don't know; "Which grapes are never used to

TABLE 2 Summary table of the sociodemographic information of participants in the projective mapping with ultra-flash profiling (PM-UFP) ($n = 68$) and polarized sensory positioning (PSP) ($n = 91$) study including gender, age, ethnicity, rice, and alcoholic beverage consumption.

PM with UFP sociodemographic information		
Groups	**(*n*)**	**(%)**
Gender		
Female	32	47.1
Male	36	52.9
Age[a]		
18–24	18	26.9
25–39	43	64.2
40+	6	8.9
Frequency of consuming alcohol[a]		
More than once a week	14	20.9
At least once a week	23	34.3
Every second week	10	14.9
Once a month	20	29.9
Ethnicity[a]		
New Zealand/Australian European	15	22.4
East Asian[b]	20	29.9
South Asian[c]	11	16.4
Americas	9	13.4
European[d]	7	10.4
Middle Eastern/African[e]	4	6.0
Māori/Pacific Islander	1	1.5
PSP sociodemographic information		
Groups	**(*n*)**	**(%)**
Gender		
Female	33	36.3
Male	58	63.7
Age		
18–24	32	35.2
25–39	46	50.5
40+	13	14.3
Frequency of consuming alcohol		
More than once a week	25	27.4
At least once a week	26	28.6
Every second week	16	17.6
Once a month	24	26.4
Ethnicity[a]		
New Zealand/Australian European	26	29.2
East Asian[b]	22	24.7
South Asian[c]	21	23.6
European[d]	6	6.7
Americas[e]	3	3.4
Middle Eastern/African[f]	7	7.9
Māori/Pacific Islander	4	4.5

[a]Missing data from the sociodemographic section, percentage is calculated based on the available information.
[b]East Asian/Southeast Asian includes individuals of Japanese, Korean, Indonesian, Filipino, and Vietnamese descent or who address themselves as East Asian in the ethnic group section.
[c]South Asian includes individuals of Indian, Sri Lankan, or Fiji Indian descent.
[d]European includes individuals of German, Spanish, or British descent or individuals who address themselves as Europeans in the ethnic group section.
[e]Americas includes individuals from North America (e.g., United States) and Latin/South America (e.g., Chilean, Mexican, and Peruvian).
[f]Middle Eastern/African includes individuals with Iranian, Kenyan, South African, and no specified individuals from the African and Middle Eastern region.

make Champagne?" Chardonnay, **Riesling**. Pinot Noir, Pinot Meunier, and I don't know; "Which is not a famous French wine region?" Bordeaux, Champagne, **Rheingau,** Alsace, I don't know; What is the name of New Zealand's famed Sauvignon Blanc region? Kapiti, Hawke's Bay, Waipara, **Marlborough,** I don't know (Ellis & Caruana, 2018; Forbes et al., 2008). Subjective wine knowledge selected for both experiments differed slightly from each other; PM with UFP experiment used the modified version of the subjective wine knowledge questions by Wong, Owens, et al. (2023) which was derived from Flynn and Goldsmith (1999), Forbes et al. (2008) and Ellis and Caruana (2018), while the PSP experiment where taken verbatim from Ellis and Caruana (2018) and was derived from (Flynn & Goldsmith, 1999). Participants were required to select the answer that best describes their situation on a 7-point category scale from "*disagree strongly*" to "*agree strongly*." The four subjective wine knowledge questions used for PM with UFP experiment include: "Among my circle of friends, I'm one of the experts on wine" (Q1), "Compared to most other people, I know less about wine" (Q2), "I am quite familiar with wine" (Q3), and "I feel very knowledge about" (Q4) (Ellis & Caruana, 2018; Flynn & Goldsmith, 1999; Forbes et al., 2008; Wong, Owens, et al., 2023). For PSP experiment, the subjective wine knowledge consists of nine questions including: "I know pretty much about wine" (Q1), "I know how to judge the quality of the bottle of wine" (Q2), "I think I think enough about wine to feel pretty confident when I make a purchase" (Q3), "I do not feel very knowledge about wines" (Q4), "Among my circle of friends, I'm one of the 'experts' on wines" (Q5), "I have heard of most of the new wines that are around" (Q6), "Compared to most other people, I know less about wines" (Q7), "When it comes to wine, I really don't know a lot"(Q8), and "I can tell whether a bottle of wine is worth the price" (Q9) (Ellis & Caruana, 2018).

For both PM with UFP and PSP, researchers used the self-prioritization method as part of the sociodemographic questions where participants were asked to select one specific ethnic group with whom they strongly associate (Kukutai & Callister, 2009). Where appropriate, the researchers grouped smaller ethnic groups that best represented the sociodemographic information of the participants. For example, the East Asian ethnic group shown in Table 2 consists of individuals who self-identify as Chinese, Japanese, Korean, Indonesian, Vietnamese, Filipino, or regions in East and Southeast Asia. Classification of specific ethnic groups such as East Asian, South Asian, and European are explained in the footnote of Table 2. New Zealand and Australian Europeans are defined as individuals who have strong affiliations with New Zealand or Australia (e.g., by citizenship or strong cultural identity with either New Zealand or Australia) with European ancestry.

Table 2 shows the sociodemographic information of participants taking part in the PM with UFP and PSP experiment. Sixty-eight participants completed the PM with UFP experiment with a gender distribution of 47.1% ($n = 32$) female participants and 52.9% ($n = 36$) male participants. Ninety-one participants took part in the PSP experiment with a gender distribution of 36.3% ($n = 33$) female participants and 63.7% male participants ($n = 58$).

2.3 | Sensory evaluation procedures

Both experiments were advertised using social media, word-of-mouth, and posters around the Auckland University of Technology (AUT) City campus. Both PM with UFP and PSP took place in the AUT Food Science Laboratory with the temperature set at 22°C. Still water and plain water crackers (Countdown, Australia) were available for palate cleansing between samples of the PM with UFP and PSP experiments. Palate cleansing was not enforced for PM with UFP; however, PSP instructions required participants to cleanse their palate between each sample (e.g., take a sip of water and a bite of the plain water crackers). A minute (60 s) waiting time between each sample was strictly enforced in the PSP experiment with timers provided to the participants. PM with UFP experiment was conducted in October 2019, while PSP was conducted in March 2020 separately from each other. Participants who attended the PM with UFP experiment were not excluded from the PSP experiment; however, it was not a requirement that participants needed to attend both. Upon arrival at the sensory evaluations, participants were presented with an information sheet describing the nature and purpose of the experiment (either PM with UFP or PSP), a participant consent form, a set of printed questionnaire surveys, and instructions for the experiments. PM with UFP consists of an A3 piece of paper and a set of sociodemographic questions which will be discussed in Section 2.3.1. PSP consists of a set of questions including a page for "poles" training and sampling, questions regarding the PSP questions, and overall liking of the sample presented on a 100 mm unstructured line scale anchored dislike extremely (left end) and like extremely (right end) will be discussed in Section 2.3.2.

2.3.1 | PM with UFP testing

PM was selected for experimentation due to its richness in information that allows researchers to understand the sensory attributes of multiple products simultaneously. The results from PM are often presented with a perceptual map and are accompanied by UFP, allowing participants to develop a larger range of words describing the samples. Before the experiment took place, a researcher explained the instructions and told the participants to familiarize the alcoholic beverages presented to the participants and their primary goal was to compare the similarities and differences between each alcoholic beverage. The researcher explained to the participants that they had to organize the 12 samples according to their criteria on an A3 sheet of white paper (42×30 cm^2). Participants were advised that similar alcoholic beverages should be placed close together, while different samples should be located further away. Participants were encouraged to write three to five words to describe each sample to why the samples were placed in a specific location. Examples of different perceptual maps were located around the Food Science Laboratory to demonstrate how participants can group their alcoholic beverages. Examples of the perceptual map include New Zealand Political parties, International Airlines, and different variations of colors. The perceptual map examples were not extracted from peer-reviewed articles or formal scientific research. All example perceptual maps were created by the researcher, and they do not specify the criteria or reasoning for the grouping to avoid creating bias among participants taking part in the PM with UFP experiment.

2.3.2 | PSP testing

Before the participants started the PSP experiment, participants were instructed to first consume the three poles (R1, R2, and R3) and to familiarize the flavor, taste, texture, and visual attributes. Participants were then instructed to evaluate the nine samples against the three poles and to quantify the degree of difference using a bi-polar 100 mm line scale from "*exactly the same*" to "*completely different*." Overall liking was also asked during the study with nine of the samples, using a 100-mm line scale from "*extremely dislike*" to "*extremely like*" after the participants compared the sample against the three poles.

2.4 | General data analysis

All data from PM with UFP and PSP experiments were first measured by the researchers and inputted into an Excel spreadsheet for further processing. Statistical analysis for both PM and PSP experiments was analyzed using the R language software (version 4.2.0) and the Excel Addinsoft XLSTAT extension program (Addinsoft, USA). R packages used in this paper include "FactoMineR" (Lê et al., 2008) analyzing and visualizing the sensory data. Other R programs used include "cluster" for the hierarchal cluster analysis. The level of statistical significance was set at 0.05. Further description of the statistical methods used for PM with UFP is discussed in Section 2.4.1 and for PSP is discussed in Section 2.4.2.

2.4.1 | PM with UFP data analysis

To analyze the PM data, data were first separated into two parts: quantitative and qualitative. For quantitative analysis, all alcoholic beverage samples on the A3 piece of paper were located using *X* and *Y* coordinates. The *X* and *Y* coordinates of each sample were determined by using the left bottom corner of the A3 sheet of paper (landscape layout) as the origin of the coordinates. MFA was used to analyze the *X* and *Y* coordinates of the alcoholic beverages (Pagès et al., 2010).

The qualitative data of PM (e.g., UFP) were first transcribed onto an Excel spreadsheet as single words that participants used to describe the alcoholic beverages on the A3 piece of paper. Due to the range of words used to describe each sample, the researchers consolidated words that have similar meanings into a smaller number of attributes that best represent the alcoholic beverages described by the participants. For example, if two or more words have similar meanings, for example, "disgusting," "horrible," and "terrible"; these words were integrated into one word, for example, "unpleasant." A set of 12 words, including *astringent*, *bitter*, *creamy*, *dark*, *dry*, *fruity*, *light*, *pleasant*, *sour*, *strong*, *sweet*, and *unpleasant*, were selected to best represent the word description that participants used to describe the alcoholic beverage samples. Cochran's *Q* test was performed to test for statistical significance ($p < .05$) among the 12 samples with sensory attributes. When statistical significance was observed, a post hoc test was performed by using McNemar's test with Bonferroni alpha adjustment and only on items that were mentioned in over 20% of participants being selected. Correspondence analysis (CA) was carried out to visualize the interaction between the sensory attributes and alcoholic beverages. Graphical representation of the CA data is computed through R language while Cochran's *Q* test and McNemar's test with Bonferroni alpha adjustment was performed using Addinsoft XLSTAT (Addinsoft, USA).

2.4.2 | PSP data analysis

Data from the overall liking of nine samples and each of the three poles were analyzed using one-way analysis of variance (ANOVA). Tukey's post hoc test was carried out when statistical significance was observed. Like PM with UFP, PSP information, such as the three poles, was analyzed using MFA.

2.4.3 | Hierarchical cluster analysis and RV coefficient analysis

Hierarchical cluster analysis (HCA) with Euclidian distances, Ward's aggregation criterion was used to identify the different cluster groups of participants in both PM with UFP and PSP experiments. The cluster group was determined by the answers of the objective and subjective wine knowledge information given by participants; however, only subjective wine knowledge was used in the PM with UFP to construct the different cluster groups due to many participants not answering the questions in the format that was given or avoiding this part of the sensory experiment entirely. Once cluster groups were identified in both PM with UFP and PSP, participants were separated into their respective groups to evaluate how each cluster group performed for the PM with UFP and PSP using MFA.

RV coefficients were employed to understand the similarity between two matrices between the cluster groups within both PM with UFP and PSP experiments (i.e., to what degree does one MFA map resemble the other). RV coefficient allows researchers to compare perceptual maps such as MFA and principal component analysis using numerical values such as Dimension 1 and Dimension 2 against different groups of participants or samples. Josse et al. (2008) state that the RV coefficient can be interpreted similarly to the Pearson correlation coefficient with multivariate data. Only the first two dimensions of the MFA results were used for calculation; these results include the general MFA generated from the PM with UFP and PSP and the cluster group identified from HCA. Different cluster groups were not evaluated between PM with UFP and PSP experiments. RV coefficient ranges between 0 and 1, if the value is close to 1 this indicates that there is a higher degree of similarity between the perceptual maps (Louw et al., 2013). Several research articles have indicated that an RV value over 0.75 is considered high in the similarity between the perceptual maps (Kennedy, 2010; Lawless & Glatter, 1990); however, some researchers stated that an RV value of around 0.95 is more preferable (Schlich & Guichard, 1989). Significant tests for the RV coefficient were performed using a permutation test, where statistical significance signals that the configuration of the perceptual map is similar (Josse et al., 2008).

3 | RESULTS AND DISCUSSION

3.1 | Cochran's *Q* test and pairwise McNamar's test for PM with UFP

Twelve attributes were identified by the researchers as important and encompass the sensory attributes used by all participants who took part in the PM with UFP experiment. Cochran's *Q* test was applied to the 12 attributes and showed that 10 were statistically significant including *dark*, *dry*, *sweet*, *sour*, *bitter*, *creamy*, *strong*, *light*, *fruity*, and *unpleasant*. Further analysis using pairwise McNamar's test showed that *bitter*, *fruity*, and *sour* were statistically significant.

Participants associated bitterness more with beer samples compared to wine and *makgeolli* samples, which is not surprising as bitterness is a common taste characteristic of beer with 80% of its bitterness derived from the addition of hops during the boiling stage of the beer brewing process (Oladokun et al., 2016). It is important to note that bitterness is a common taste in all alcoholic beverages, but the causes of the bitterness can be attributed to different reasons. For example, the addition of hops in beer production which contain α-acids such as humulones which converts to iso-α-acids, the principal source of bitterness (Luo et al., 2020; Oladokun et al., 2016) while wine bitterness can be attributed to phenolic compounds such as catechin, epicatechin, caffeic acid, and quercetin for wine (Luo et al., 2020; Rudnitskaya et al., 2010). In comparison, non-volatile compounds such as peptides and bitter amino acids are key contributors to the bitter taste of rice wine (Luo et al., 2020). Examples of bitter peptides include QLFNPS, QLFNPSTNP, QLFNPSTNPWH, QLFNPSTNPWHSP, and QLFGPNVNPWHNP were sobered in the pre-fermentation stages of Japanese rice wine (Maeda et al., 2011).

For the *fruity* term, participants tend to use these to describe wine samples more than beer and *makgeolli* samples. Sauvignon Blanc was perceived as the *fruitiest* alcoholic beverage examined in the PM with UFP experiment with 32.4% of participants commenting on their perceptual map, followed by Shiraz with 23.1% of participants. Both IPA and Pilsner had 13.2% of participants using fruity terms to describe these two beer samples, and the least fruity sample among the 12 alcoholic beverages examined was Porter with 2.90% of participants using fruity terms to describe this beer sample. For *makgeolli*, both 1SF-YN and 3SF were noted as the *fruitiest* among 11.8% of participants compared to other *makgeolli* samples, 8.80% for 2SF and 7.40% for 1SF-N. These findings are consistent with scientific literature, as consumers tend to describe wine products with fruitier attributes, such as Sauvignon Blanc, which is often associated with green capsicum flavor (Parr et al., 2007) or Chardonnay with fruity aromas (e.g., citrus, passion fruit and more) (Gambetta et al., 2014). The fruity aroma in wine products is likely to be caused by a number of factors, such as amino acid metabolism, enzymatic formation of esters, or secondary fermentation, also known as malolactic fermentation (Styger et al., 2011).

For *sour*, participants used more sour terms to describe *makgeolli* than beer and wine. Around 27.9% of participants used sour terms to describe 1SF-N, followed by 2SF (25.0% of participants) and then 1SF-YN (19.1% of participants). Similar to fruity terms and the association with wine products, using sour terms to describe *makgeolli* or KRW was found in a number of studies (Jung et al., 2014; Kwak et al., 2015; Wong, Muchangi, et al., 2023; Wong, Owens, et al., 2023). In a study conducted by Wong, Muchangi, et al. (2023), the researchers showed a number of organic acids were present in *makgeolli* samples used in this study including pyruvic acid, malonic acid, succinic acid, citric acid, malic acid, tartaric acid, lactic acid and also acetic acid. 1SF-N had higher levels of citric acid, malic acid, and tartaric acid compared to the other *makgeolli* samples; this may explain the high perceived sourness of 1SF-N among participants in the PM with UFP experiment. Another study conducted by Wong, Owens, et al. (2023) also indicated that sourness was present in all *makgeolli* samples using sensory evaluation (Check-All-That-Apply). Seventy-seven percent of participants from their study selected 1SF-N sample to be the sourest, followed by 3SF with 28.7% of participants.

3.2 | CA and MFA for PM

Figure 1 is the CA bi-plot map of the qualitative data extracted from the PM with UFP experiment and was formulated after the attributes were converted to a contingency table. The CA map was designed to aid researchers in visualizing the interaction between alcoholic beverages and the sensory attributes identified in the PM with UFP experiment. In Figure 1, the first two dimensions explained a total of 71.4% of the total variance (Dimension 1 = 45.5% and Dimension 2 = 25.9%). Key attributes that were of interest for this research include "bitter," "fruity" and "sour" due to statistical significance reached in Cochran's *Q* test and pairwise McNamar's test. As expected, *sour* and all *makgeolli* samples can be seen positioned on the top left quadrant alongside other sensory attributes such as *creamy*, *astringent*, *strong*, and *unpleasant*. The CA map from the PM with UFP somewhat mirrors the findings published in Wong, Owens, et al. (2023) study as participants in their study also used the terms *astringent* and *creamy* to describe *makgeolli* samples. Wine samples such as Chardonnay, Rosé, and Sauvignon Blanc clustered around the term *fruity*, which supports the Cochran's *Q* test and pairwise McNamar's test that participants used more *fruity* terms to describe wine than beer and *makgeolli*. Pale Ale and IPA are relatively close to *bitter* due to the high number of participants using this term to describe these alcoholic beverages. Group clustering of alcoholic beverages was less obvious as the location of alcoholic beverage samples was determined by the attributes that they share on the contingency table.

Figure 2 is the MFA map constructed from the PM with UFP experiment position of the beer, wine, and *makgeolli* samples on the A3 piece of paper. Unlike Figure 1, where the CA map is based on qualitative information, the MFA map of PM with UFP experiment is based on the coordinates arranged by the participants. The first and second dimensions of the PM with UFP experiment explained 47.4% of the variance of the experimental data (Dimension 1 = 25.0% and Dimension 2 = 22.3%; Figure 2). From the PM with UFP MFA map, participants separated the *makgeolli*, beer, and wine samples into three groups. This is an indication that participants do not perceive *makgeolli* as having similar traits to either beer or wine when placing the alcoholic beverage sample on the A3 piece of paper.

All *makgeolli* samples are grouped in the negative values of Dimension 1, while all the beer samples, including Porter, Pale Ale, Pilsner, and IPA, are placed in the positive value. All wine samples, including Sauvignon Blanc, Chardonnay, Rosé, and Shiraz, are positioned in the positive value of Dimension 2. Although previous research indicates that *makgeolli* tends to share some wine traits such as Rosé and semi-sweet white wine (Kwak et al., 2015), participants in the PM with UFP experiment show that *makgeolli* was categorized in its distinctive group. Based on the information extracted in Figure 2, it is hard to conclude the reasons for their group categorization because additional qualitative information, such as focus groups or participant interviews, is required. However, it was likely that participants grouped the alcoholic beverage based on alcoholic beverage class (e.g., beer or wine), sensory attributes such as *bitter*, *sour*, and *fruity* that were noted as significant in Section 3.1, or other external factors may be contributing factors to alcoholic beverage placement on the perceptual map that is unforeseen by the researchers. It should be noted that the MFA map constructed by the PM with UFP experiment in Figure 2 was relatively low in explaining the total variance of the alcoholic beverages; this can be attributed to the low agreement of the alcoholic beverage sample placement on the perceptual map.

Previous research has seen discrepancies in product clustering between consumers who are either knowledgeable or familiar with the food product (including experts or trained panelists) and novices

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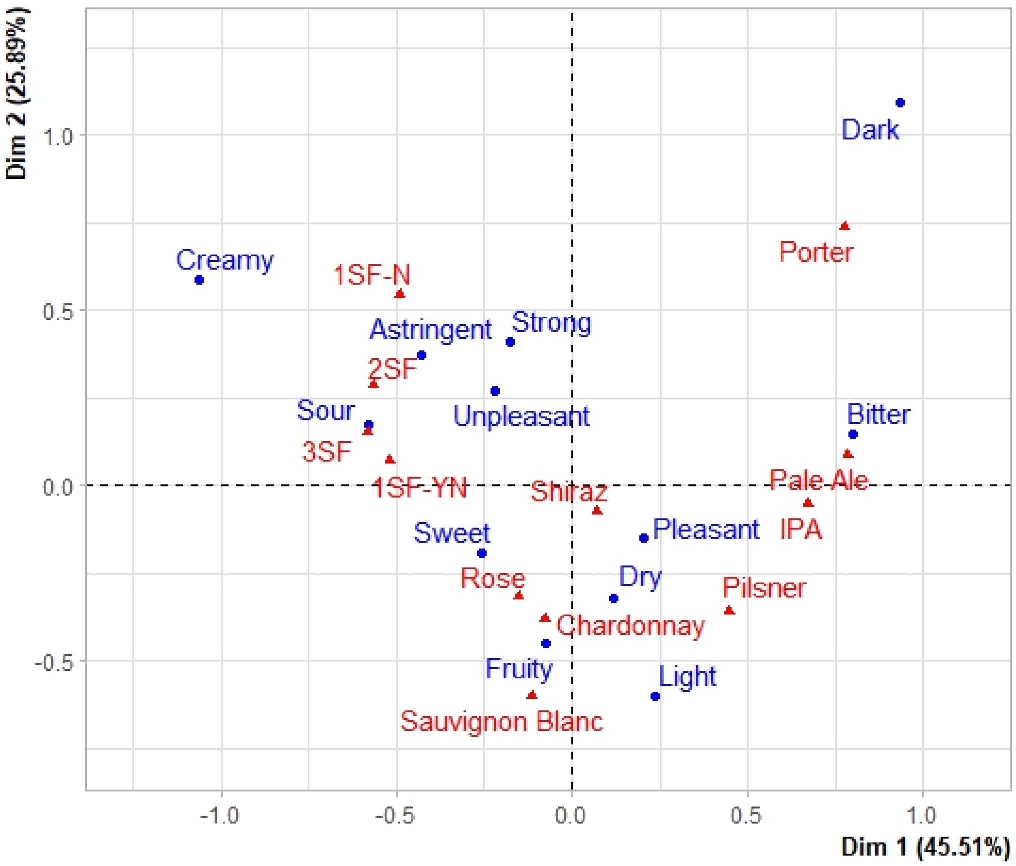

FIGURE 1 Correspondence analysis of the participants' ($n = 68$) attributes describing the 12 alcoholic beverages in the projective mapping experiment and the corresponding alcoholic beverage consisting of beer, wine, and *makgeolli*. Red terms refer to the alcoholic products and blue terms refer to the terms used within the PM with UFP experiment. PM, projective mapping; UFP, ultra-flash profiling.

(e.g., consumers with limited knowledge) in PM. From the literature, experts (e.g., individuals with high knowledge and familiarity with the product) tend to have higher discriminability and can identify product duplicates in PM, while consumers with limited knowledge cannot (Barton et al., 2020; Nestrud & Lawless, 2008). Participants were further divided based on their wine knowledge to determine the similarities and differences of each perceptual map in this study. This is due to research indicating how product knowledge influences the behavior of categorizing products (Chocarro Eguaras et al., 2012) and to understand how different cluster groups contribute to the total variance explained in the overall PM with UFP MFA map.

3.3 | HCA and RV coefficient for PM with UFP

Based on the subjective wine knowledge results reported by participants, four clusters were identified using HCA. Consumer wine product knowledge is important information for producers as it allows them to understand the decision-making process while purchasing wine in the marketplace (Ellis & Caruana, 2018). The level of involvement and knowledge also impacts how consumers rank in the order of importance on intrinsic (e.g., flavor and taste) and extrinsic (e.g., packaging and brand name) properties of the wine product (Bruwer et al., 2017). For example, Ellis and Caruana (2018) identified four segments of wine consumers based on their subjective and objective wine knowledge score: neophytes (e.g., scored low for both subjective and objective wine knowledge), snobs (e.g., scored high in subjective wine knowledge but low on objective wine knowledge), modest (e.g., scored high in objective but low in wine knowledge), and experts (e.g., scored high in both subjective and objective wine knowledge). A follow-up study showed that consumer groups in neophytes and experts are more likely to have variety-seeking behavior which implies that there is low customer retention and loyalty to the wine product among these two groups of consumers (Ellis & Mattison Thompson, 2018). Like Ellis and Caruana (2018), this paper uses the subjective and objective wine knowledge scale to segment and identify the different consumer groups among the subjects.

Four cluster groups were identified with Cluster 1 consisting of 22.7% participants, Cluster 2 consisting of 34.8%, Cluster 3 consisting of 16.7%, and Cluster 4 consisting of 25.8% participants (for a brief description of each cluster group, see Supporting Information SI.1). Cluster 1 tends to rate their subjective wine knowledge higher than the other cluster groups and Cluster 2 participants indicated that they are familiar with wine. Cluster 3 participants indicated that they are

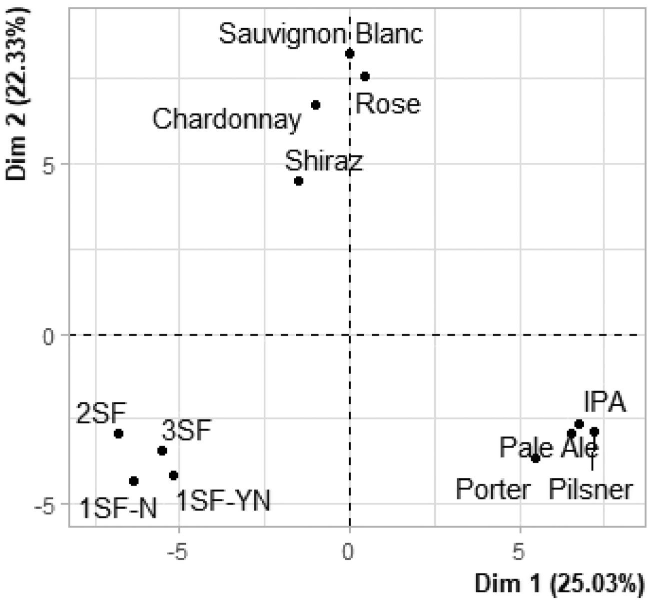

FIGURE 2 Multiple factor analysis (MFA) map from the projective mapping with ultra-flash profiling (PM with UFP) experiment constructed by participants ($n = 68$) grouping *makgeolli* samples among wine and beer products. The total variance of the PM with UFP MFA map is 47.4% (Dimension 1 = 25.0% and Dimension 2 = 22.3%).

not familiar with wine, while Cluster 4 participants are familiar with wine but not knowledgeable of wine. The visual representation of the alcoholic beverages seems to be grouped relatively similar to the overall PM with UFP MFA map; however, the rotation of the three alcoholic groups is different (see Supporting Information SI.1).

The comparison of the RV coefficient results between different cluster groups is shown in Table 4 with its p value level of significance. The RV coefficient between Cluster 1 and Cluster 2 is 0.917 ($p < .001$), indicating that the results are similar and there is a general agreement in the grouping of the 12 alcoholic beverages. The results between Cluster 1 and Cluster 4 are relatively low with an RV coefficient of 0.645 ($p < .01$), indicating that the grouping criteria may have been different in the PM with UFP experiment between the two clusters of participants. Based on the guidelines set out by Kennedy (2010) and Lawless and Glatter (1990) show that Cluster 1 participants and Cluster 4 participants may have used different sets of criteria to sort the 12 alcoholic beverages on the perceptual map. The RV coefficients when comparing Cluster 4 to Cluster 2 and Cluster 3 were 0.740 ($p < .001$) and 0.718 ($p < .001$), respectively. For further details of the individual cluster group's RV coefficient value compared against the overall PM with UFP MFA map in Figure 2, see Supporting Information SI.2 for the RV coefficient and p value. From the RV coefficient comparison, subjective wine knowledge may have influenced the way the 12 alcoholic beverages were grouped during the PM with UFP experiment and there is a potential attribute that participants are using to categorize beer, wine, and *makgeolli* that is unknown to the researchers. The qualitative information from the PM with UFP showed that there is a possible interaction based on three sensory attributes including *bitter*, *sour*, and *fruity*. Further investigation for the categorization of the *makgeolli* was warranted as two cluster groups (e.g., Cluster 3 and Cluster 4) indicated that Shiraz was sharing sensory attributes with *makgeolli* that the researchers were not aware or sorted within close proximity between *makgeolli* samples and Shiraz. This is likely due to their low subjective wine knowledge and their criteria of grouping the 12 alcoholic beverages were different compared to Cluster 1 and Cluster 2.

3.4 | PSP and one-way ANOVA

In Table 4, one-way ANOVA showed strong statistical significance in the mean hedonic ratings among the alcoholic beverages ($n = 9$) among the alcoholic beverages in the PSP experiment ($F = 10.23$; $p < .001$). The degree of significance is denoted as letters, mean hedonic rating, and the standard deviation are shown in Table 4. Chardonnay was rated the highest among the nine alcoholic beverage samples with a mean score and standard deviation of 67.9 ± 20.3 mm, followed by 2SF (60.2 ± 24.9 mm) and Rosé (59.7 ± 23.5 mm) on the 100 mm line scale; however, all were not statistically different. The least-liked alcoholic beverage was 3SF with a hedonic score of 39.9 ± 28.7 mm and was not statistically different compared to 1SF-N (48.7 ± 25.2 mm), and 1SF-YN (48.4 ± 28.5 mm). A possible explanation for the high hedonic rating toward grape wines (apart from 2SF) in the PSP experiment likely to be the familiarity of grape wines among New Zealand participants. High familiarity with a food product (e.g., Chardonnay and Rosé) allows consumers to form positive expectations, thus increasing the overall acceptance of the food product (Hong et al., 2014; Park et al., 2020). The low hedonic rating of *makgeolli* samples, such as 1SF-N, 2SF, and 3SF, could be attributed to the lack of familiarity and experience consuming the product (Choe & Hong, 2018).

One-way ANOVA was also performed to compare the similarities and differences between the different alcoholic beverages against R1 (Chardonnay as pole 1) ($F = 53.46$; $p < .001$), R2 (Shiraz as pole 2) ($F = 85.27$; $p < .001$), and R3 (1SF-N as pole 3) ($F = 61.80$; $p < .001$) to understand the sensorial differences of each alcoholic beverage. Each reference sample (e.g., R1, R2, and R3) represents either white wine (e.g., Chardonnay), red wine (e.g., Shiraz), and *makgeolli* (e.g., 1SF-N) and are used as a point of reference for the participants. As expected, participants perceived the Chardonnay sample to be the closest to R1 with 25.0 ± 22.1 mm followed by Sauvignon Blanc (32.0 ± 25.5) but were not statistically different between the two as participants perceived the sensorial attributes to be similar. Rosé (40.0 ± 25.0 mm) was statistically significant compared to Chardonnay but not Sauvignon Blanc. 3SF was the most different alcoholic beverage sample (77.5 ± 22.5 mm) compared to R1 according to the participants but was not statistically different from Cabernet Sauvignon (70.4 ± 24.9 mm), 2SF (69.9 ± 26.6 mm), 1SF-YN (68.3 ± 26.3), and Shiraz (68.1 ± 27.8 mm). Based on qualitative information from PM with UFP experiment, it is likely that 3SF shares similar sensory attributes such as *fruity*, *sour*, and *sweet* with Cabernet Sauvignon, 2SF, 1SF-YN, and Shiraz. Due to the design of the PSP experiment, it is difficult to have a conclusive answer without the aid of chemical analysis or including the use of other sensory evaluation methods such as descriptive analysis.

Shiraz (26.5 ± 24.7 mm) was rated as the closest sample to R2 followed by Cabernet Sauvignon (26.7 ± 23.6 mm) but are not statistically significant due to the fact that they are both red wines. Table 4 shows that Rosé (65.8 ± 25.2 mm) was the third sample that was most similar to R2; however, it was interesting to note that participants in this study rated Rosé to have closer sensory attributes to Chardonnay than Shiraz. According to literature, Rosé shares both elements of red and white wines due to its processing method. For example, some red grapes must be added to the fermentation process and drained after a short maceration or maintaining macerating grapes with their skins after crushing (Guerrini et al., 2022). From flavor analysis using SPME-GC-MS, researchers noted that white and Rosé wines have higher concentrations of ethyl esters of fatty acids (EEFAs) (Antalick et al., 2014). The cause of higher concentrations of EEFAs is due to the winemaking condition, where restricting oxygen levels such as carbonic maceration is a common practice in producing white and Rosé wine. In comparison, red wines have higher concentrations of ethyl esters of branched acids (EEBAs) which is possibly due to the grape skin contact during processing and malolactic fermentation (Antalick et al., 2014). From sensory science, participants tend to struggle with categorizing and characterizing Rosé due to its unique feature of having different shades of red. Ballester et al. (2009) observed that participants struggled to sort Rosé wine into groups and were less accurate compared to white and red wine. In this study, it was surprising to observe that participants rated the Rosé wine sample more closely to R1 (Chardonnay) than R2 (Shiraz) as all the alcoholic beverages were visible to the participants, Participants rated 1SF-N as the closest sample to R3 (1SF-N) with a mean score of 26.6 ± 22.6 mm. Grape wines, including Rosé (72.2 ± 27.2 mm), Sauvignon Blanc (72.4 ± 24.0 mm), Chardonnay (74.5 ± 24.2 mm), Cabernet Sauvignon (77.7 ± 24.2 mm), and Shiraz (78.8 ± 24.5 mm), were not statistically significant between each other but was statistically significant to all *makgeolli* samples.

3.5 | MFA for PSP

The PSP MFA map was constructed based on the information provided by participants while comparing the similarities and differences of each alcoholic beverage against R1, R2, and R3. The first and second dimensions of the PSP MFA map explained 61.5% (Dimension 1 = 35.8% and Dimension 2 = 25.7%) in Figure 3, a slight increase from the PM with UFP MFA map indicating that the PSP MFA map captured more information while determining the group clustering of the nine alcoholic beverage samples. Compared to the PM with UFP MFA map, there was a high consensus in categorizing the alcoholic beverage samples using PSP. As stated earlier, the PSP experiment was more directive and required participants to follow specific

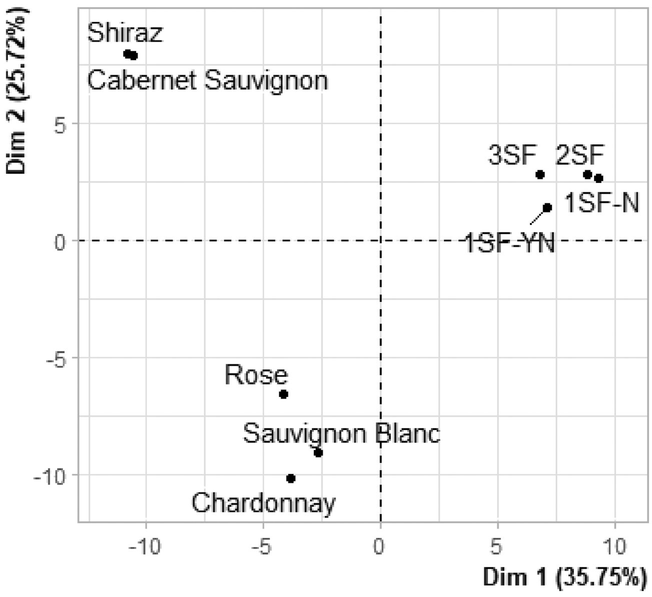

FIGURE 3 PSP-MFA map of comparing alcoholic beverages ($n = 9$) in the PSP experiment against three poles (Chardonnay, Shiraz, and 1SF-N). The total variance of the PSP-MFA bi-plot map is 61.5% (Dimension 1 = 35.8% and Dimension 2 = 25.7%). MFA, multiple factor analysis; PSP, polarized sensory positioning.

instructions from the researchers. Specific sensory attributes and characteristics were pre-determined by the researchers, where participants compared the samples against the three poles prescribed by the researcher. In Figure 3, three groups of alcoholic beverages can be observed (e.g., red wine, white wine, and *makgeolli*). All the wine samples, including Shiraz, Cabernet Sauvignon, Rosé, Sauvignon Blanc, and Chardonnay, are in the negative values of Dimension 1, while all the *makgeolli* samples are in the positive value. For Dimension 2, all the *makgeolli* samples and red wines (e.g., Shiraz and Cabernet Sauvignon) are in the positive value, while all the white wines (e.g., Sauvignon Blanc and Chardonnay) are in the negative value. Interestingly, Rosé is grouped in the white wine cluster which was likely due to the high concentrations of EEFAs that they tend to share.

3.6 | HCA and RV coefficient for PSP

Participants were separated into individual clusters that best represent their knowledge of wine for further analysis to determine whether the clustering of the nine alcoholic beverages based on three poles or reference samples was affected. Like PM with UFP, participants were separated based on their wine knowledge, however, objective wine knowledge questions were also included in the HCA process due to the fact all participants took part in answering the questions with no missing data. Four clusters were identified: Cluster 1 consists 19.8% of participants, Cluster 2 consists 22.0%, Cluster 3 consists 25.3%, and Cluster 4 consists 32.9%, respectively. Cluster 1 had low subjective and objective wine knowledge, while

Cluster 2 scored relatively higher in objective wine knowledge but still low in subjective wine knowledge. Cluster 3 had the most correct answers for objective wine knowledge, while Cluster 4 was relatively high compared to the other Clusters. A detailed description of each cluster group is discussed in Supporting Information SI.3.

Compared to the RV coefficient performed on the different clusters of PM with UFP, the RV coefficient for the paired comparison of PSP clusters was high; all are above 0.95 as shown in Table 3. The high RV coefficient indicates that MFA maps produced by PSP participants are in strong agreement between each cluster group in their product configuration on the MFA map, even though the rotations of sample placements are different. Participants with different subjective and objective knowledge of wine are able to perceive and use the same sensorial clues to characterize different alcoholic beverages and to use this information for categorization.

TABLE 3 Summary table of RV coefficient comparison values between different PM with UFP cluster groups and their MFA map results in conjunction with PSP cluster groups and their MFA map results.

PM cluster comparison	RV coefficient
PM Cluster 1 versus PM Cluster 2**	0.917
PM Cluster 1 versus PM Cluster 3**	0.836
PM Cluster 1 versus PM Cluster 4*	0.645
PM Cluster 2 versus PM Cluster 3**	0.870
PM Cluster 2 versus PM Cluster 4**	0.740
PM Cluster 3 versus PM Cluster 4**	0.718
PSP cluster comparison	**RV coefficient**
PSP Cluster 1 versus Cluster 2**	0.950
PSP Cluster 1 versus Cluster 3**	0.972
PSP Cluster 1 versus Cluster 4**	0.977
PSP Cluster 2 versus Cluster 3**	0.972
PSP Cluster 2 versus Cluster 4**	0.950
PSP Cluster 3 versus Cluster 4**	0.976

Note: *Statistical significance level $p < .01$; **Statistical significance level $p < .001$.
Abbreviations: MFA, multiple factor analysis; PM, projective mapping; PSP, polarized sensory positioning; UFP, ultra-flash profiling.

3.7 | General discussion

Research on the perception of *makgeolli* outside of Asia is very limited and market positioning of rice wine within the alcoholic beverage market might be problematic. This study was set to understand how New Zealand participants categorize and characterize *makgeolli* among other commercial alcoholic beverages and to provide some guidance in positioning *makgeolli* in the alcoholic beverage market. To the best of our knowledge, this is one of the first studies that examined the sensory interactions between *makgeolli* and other alcoholic beverages.

Although Kwak et al. (2015) paper states that Western consumers perceive KRW as belonging to the wine category of alcoholic beverages, specifically sharing similar sensory attributes with semi-sweet white wine, this was not observed in this study. The results from PM with UFP MFA map show that there are three distinctive groups (e.g., wine, beer, and *makgeolli*). From the qualitative data of the PM with UFP, participants indicate that *makgeolli* samples are sourer than wine and beer samples. Beer differs from wine and *makgeolli* samples due to its bitter taste and participants indicated that wine has more fruity attributes than the other class of alcoholic beverages. From the PM with UFP MFA map, it was interesting to see how participants categorize *makgeolli* separately from beer and wine. When participants were divided into specific clusters from PM with UFP experiments based on wine subjective knowledge, Shiraz was placed relatively close to *makgeolli* samples in two cluster groups (Cluster 3 and Cluster 4). Participants from PM with UFP experiments allocated into Cluster 3 and Cluster 4 do not frequently consume alcoholic beverages and also noted that their subjective wine knowledge is low compared to their peers. Cluster 4 from the PM with UFP experiment, had the lowest total explained variance (42.1%) which

TABLE 4 PSP results from participants ($n = 91$) including mean hedonic rating, similarities/differences compared to R1 (Chardonnay), R2 (Shiraz), and R3 (1SF-N) on 100 mm line scale.

Alcoholic beverages	Overall liking	R1 (Chardonnay)	R2 (Shiraz)	R3 (1SF-N)
1SF-N	48.9 ± 24.9^{bcd}	65.7 ± 27.0^{b}	76.3 ± 24.5^{abcd}	26.6 ± 22.6^{d}
1SF-YN	47.2 ± 28.7^{cd}	68.3 ± 26.3^{ab}	81.5 ± 17.4^{ab}	42.9 ± 26.9^{bc}
2SF	60.2 ± 24.9^{ab}	69.9 ± 26.6^{ab}	78.6 ± 21.3^{abc}	33.6 ± 22.2^{cd}
3SF	39.5 ± 28.6^{d}	77.5 ± 22.5^{a}	83.0 ± 18.1^{a}	48.2 ± 28.8^{b}
Cabernet Sauvignon	55.0 ± 24.1^{bc}	70.4 ± 24.9^{ab}	26.7 ± 23.6^{e}	77.7 ± 24.2^{a}
Chardonnay	67.9 ± 20.5^{a}	25.0 ± 22.1^{d}	70.4 ± 23.5^{cd}	74.5 ± 24.2^{a}
Rose	59.7 ± 23.6^{ab}	40.0 ± 25.0^{c}	65.8 ± 25.2^{d}	72.2 ± 27.2^{a}
Sauvignon Blanc	57.5 ± 24.6^{abc}	32.0 ± 25.5^{cd}	71.8 ± 26.0^{bcd}	72.4 ± 24.0^{a}
Shiraz	59.0 ± 23.7^{ab}	68.1 ± 27.8^{ab}	26.5 ± 24.7^{e}	78.8 ± 24.5^{a}

Note: Results are expressed as mean ± standard deviation ($n = 91$). Statistical significance between samples is expressed as a–e superscript letters in the column for overall liking, similarities/differences compared to R1 (Chardonnay), R2 (Shiraz), and R3 (1SF-N). Statistical significance level was set at ($p < .05$).
Abbreviation: PSP, polarized sensory positioning.

suggests that there is low consensus in the criteria of characterizing and categorizing alcoholic beverages compared to the other cluster groups in the PM with UFP experiment.

The combined total variance for PM with UFP MFA map was lower than PSP MFA map, and this can be explained by two reasons. First, the PSP experimental method was more directive compared to PM with UFP with reference-based instructions to the participants (Teillet et al., 2010). Researchers need to identify specific reference points or "poles" for participants to compare the sample to characterize the food product. However, it is important to note that participants were not sorting the samples into different categories but examining whether the sample was either similar or different to the "poles" selected by the researchers. Second, the number of samples used in the PM with UFP may have reduced the total explained variance as shown in other published research (Hopfer & Heymann, 2013; Kim et al., 2019; Torri et al., 2013). Kim et al. (2019) noted that published research had lower total explained variance when samples ranged from 12 to 18 samples (21%–31%) compared to 7 to 9 samples (38%–56%) (Lelièvre et al., 2008; Lezaeta et al., 2017). Therefore, PM with UFP experiment was restricted to beer and wine samples and unable to include more alcoholic beverages such as cider, mead, or spirits without causing a lowering of combined explained variance or sensory fatigue to the participants.

From the PSP experiment, it was evident that all *makgeolli* samples do not share the same wine traits presented in this study. However, in the overall acceptance question, it was interesting to note that 2SF was the second most liked alcoholic beverage among the nine samples that were examined in the PSP experiment. In another study where the same processing of *makgeolli* was used, participants noted that 2SF had a sweeter taste than the other *makgeolli*. Sugar content analysis showed that 2SF had higher glucose and maltose content than 1SF-YN, 1SF-N, and 3SF (Wong, Muchangi, et al., 2023). In terms of other sensory attributes, 2SF has been described as having a creamier texture, pear flavor, and sweeter taste compared to the other *makgeolli*, such as 1SF-YN, 1SF-N, and 3SF. This may explain a higher overall acceptance of 2SF compared to the rest of the *makgeolli* samples. One limitation that should be addressed is that the methods used in this research paper are all sensory techniques; for future work, it would be beneficial to incorporate chemical analysis such as sugar analysis, color, and quality of the different alcoholic beverages (Ailer et al., 2020) just to name a few parameters to consider for future research development of *makgeolli* in New Zealand. However, the main focus of this research paper was to understand how participants categorized and characterized *makgeolli* among beer and wine.

With consideration of the categorization theory and *makgeolli* product, future marketing campaigns should consider positioning *makgeolli* as a separate alcoholic beverage category as participants grouped *makgeolli* into a separate alcoholic category in the PM with UFP and PSP experiments. Due to *makgeolli* being perceived differently compared to wine and beer samples from the PM with UFP and PSP experiments, a subtype strategy would be more beneficial for *makgeolli* as it can disassociate itself from other products currently in the market (Sujan & Bettman, 1989). Another benefit of using the subtype strategy is the "mere categorization effect." The "mere categorization effect" focuses on the number of categories rather than the number of offerings from the producers to the consumers (Mogilner et al., 2008). The "mere categorization effect" suggests that consumers perceive products are abundant without overloading the consumer with information about individual products are sorted into different categories (Mogilner et al., 2008). For example, producers may consider a separate section of "rice wine only" products on a food menu at a restaurant or a separate section on the store shelf to differentiate rice wine from other alcoholic beverages such as beer or wine. Other studies have also shown that increased categories of products do increase customer satisfaction; however, too many categories can potentially overload them as this relationship is best described as an inverted-U shape relationship according to Yan et al. (2015).

4 | CONCLUSION

The result from this study suggests that *makgeolli* is categorized differently compared to wine and beer. This is interesting as the process of producing *makgeolli* is similar to beer and scientific literature has noted that Western consumers perceive KRW including *makgeolli* to share similar traits to Rosé or semi-sweet white wine products. *Makgeolli* producers and marketing professionals need to consider positioning *makgeolli* differently within the alcoholic beverage market in New Zealand.

AUTHOR CONTRIBUTIONS

Barry Wong: Writing—original draft; project administration; methodology; data collection; data processing; formal analysis. **Megan Phillips**: Conceptualization; methodology; writing—review and editing; supervision. **Rothman Kam**: Conceptualization; methodology; writing—review and editing; supervision.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

Aaker, D. A., & Shansby, J. G. (1982). Positioning your product. *Business Horizons*, *25*(3), 56–62. https://doi.org/10.1016/0007-6813(82)90130-6

Ailer, Š., Valšíková, M., Jedlička, J., Mankovecký, J., & Baroň, M. (2020). Influence of sugar and ethanol content and color of wines on the sensory evaluation: From wine competition "Nemčiňany Wine Days" in Solvak Republic (2013–2016). *Erwerbs-Obstbau*, *62*, 9–16. https://doi.org/10.1007/s10341-020-00486-x

Antalick, G., Perello, M.-C., & De Revel, G. (2014). Esters in wines: New insight through the establishment of a database of French wines. *American Journal of Enology and Viticulture*, *65*(3), 293–304. https://doi.org/10.5344/ajev.2014.13133

Ares, G., Antúnez, L., De Saldamando, L., & Giménez, A. (2018). Polarized sensory positioning. In S. E. Kemp, J. Hort, & T. Hollowood (Eds.), *Descriptive analysis in sensory evaluation* (pp. 561–577). John Wiley & Sons Ltd.

Ares, G., Antúnez, L., Oliveira, D., Alcaire, F., Giménez, A., Berget, I., Næs, T., & Varela, P. (2015). Pole selection in polarized sensory positioning: Insights from the cognitive aspects behind the task. *Food Quality and Preference*, *46*, 48–57. https://doi.org/10.1016/j.foodqual.2015.07.003

Ballester, J., Abdi, H., Langlois, J., Peyron, D., & Valentin, D. (2009). The odor of colors: Can wine experts and novices distinguish the odors of white, red, and rosé wines? *Chemosensory Perception*, *2*, 203–213. https://doi.org/10.1007/s12078-009-9058-0

Barton, A., Hayward, L., Richardson, C. D., & McSweeney, M. B. (2020). Use of different panellists (experienced, trained, consumers and experts) and the projective mapping task to evaluate white wine. *Food Quality and Preference*, *83*, 103900. https://doi.org/10.1016/j.foodqual.2020.103900

Bruwer, J., Chrysochou, P., & Lesschaeve, I. (2017). Consumer involvement and knowledge influence on wine choice cue utilisation. *British Food Journal*, *119*, 830–844. https://doi.org/10.1108/BFJ-08-2016-0360

Campbell, H. (2000). The glass phallus: Pub (lic) masculinity and drinking in rural New Zealand. *Rural Sociology*, *65*(4), 562–581. https://doi.org/10.1111/j.1549-0831.2000.tb00044.x

Chocarro Eguaras, R., Elorz Domezain, M., & Miguel Múgica Grijalba, J. (2012). Consumers' internal categorization structures: An additive tree analysis. *European Journal of Marketing*, *46*(6), 760–789. https://doi.org/10.1108/03090561211214591

Chocarro, R., Cortiñas, M., & Elorz, M. (2009). The impact of product category knowledge on consumer use of extrinsic cues—A study involving agrifood products. *Food Quality and Preference*, *20*(3), 176–186. https://doi.org/10.1016/j.foodqual.2008.09.004

Choe, S. Y., & Hong, J. H. (2018). Can information positively influence familiarity and acceptance of a novel ethnic food? A case study of Korean traditional foods for Malaysian consumers. *Journal of Sensory Studies*, *33*(3), e12327. https://doi.org/10.1111/joss.12327

Durand, R., & Khaire, M. (2017). Where do market categories come from and how? Distinguishing category creation from category emergence. *Journal of Management*, *43*(1), 87–110. https://doi.org/10.1177/0149206316669812

Ellis, D., & Caruana, A. (2018). Consumer wine knowledge: Components and segments. *International Journal of Wine Business Research*, *30*, 277–291. https://doi.org/10.1108/IJWBR-03-2017-0016

Ellis, D., & Mattison Thompson, F. (2018). The effect of wine knowledge type on variety seeking behavior in wine purchasing. *Journal of Wine Research*, *29*(2), 71–86. https://doi.org/10.1080/09571264.2018.1471393

Flynn, L. R., & Goldsmith, R. E. (1999). A short, reliable measure of subjective knowledge. *Journal of Business Research*, *46*(1), 57–66. https://doi.org/10.1016/S0148-2963(98)00057-5

Forbes, S. L., Cohen, D. A., & Dean, D. L. (2008). An assessment of wine knowledge amongst global consumers. *Paper presented at the 4th international conference of the academy of wine business research*, Siena, Italy.

Gambetta, J. M., Bastian, S. E., Cozzolino, D., & Jeffery, D. W. (2014). Factors influencing the aroma composition of Chardonnay wines. *Journal of Agricultural and Food Chemistry*, *62*(28), 6512–6534. https://doi.org/10.1021/jf501945s

Golledge, R. (1963). The New Zealand brewing industry. *New Zealand Geographer*, *19*(1), 7–24. https://doi.org/10.1111/j.1745-7939.1963.tb00081.x

Goode, M. R., Dahl, D. W., & Moreau, C. P. (2013). Innovation aesthetics: The relationship between category cues, categorization certainty, and newness perceptions. *Journal of Product Innovation Management*, *30*(2), 192–208. https://doi.org/10.1111/j.1540-5885.2012.00995.x

Green, J., Parr, W., Breitmeyer, J., Valentin, D., & Sherlock, R. (2011). Sensory and chemical characterisation of Sauvignon blanc wine: Influence of source of origin. *Food Research International*, *44*(9), 2788–2797. https://doi.org/10.1016/j.foodres.2011.06.005

Gregan-Paxton, J., Hibbard, J. D., Brunel, F. F., & Azar, P. (2002). "So that's what that is": Examining the impact of analogy on consumers' knowledge development for really new products. *Psychology & Marketing*, *19*(6), 533–550. https://doi.org/10.1002/mar.100234

Guerrini, L., Corti, F., Angeloni, G., Masella, P., Spadi, A., Calamai, L., & Parenti, A. (2022). The effects of destemming/crushing and pressing conditions in rose wine production. *Australian Journal of Grape and Wine Research*, *2022*, 1–14. https://doi.org/10.1155/2022/9853264

Hong, J., Park, H., Chung, S., Chung, L., Cha, S., Lê, S., & Kim, K. (2014). Effect of familiarity on a cross-cultural acceptance of a sweet ethnic food: A case study with Korean traditional cookie (Yackwa). *Journal of Sensory Studies*, *29*(2), 110–125. https://doi.org/10.1111/joss.12087

Hopfer, H., & Heymann, H. (2013). A summary of projective mapping observations—The effect of replicates and shape, and individual performance measurements. *Food Quality and Preference*, *28*(1), 164–181. https://doi.org/10.1016/j.foodqual.2012.08.017

Jaeger, S. R., Cardello, A. V., Chheang, S. L., Beresford, M. K., Hedderley, D. I., & Pineau, B. (2017). Holistic and consumer-centric assessment of beer: A multi-measurement approach. *Food Research International*, *99*, 287–297. https://doi.org/10.1016/j.foodres.2017.05.004

Jaeger, S. R., Danaher, P. J., & Brodie, R. J. (2009). Wine purchase decisions and consumption behaviours: Insights from a probability sample drawn in Auckland, New Zealand. *Food Quality and Preference*, *20*(4), 312–319. https://doi.org/10.1016/j.foodqual.2009.02.003

Jaeger, S. R., Worch, T., Phelps, T., Jin, D., & Cardello, A. V. (2020). Preference segments among declared craft beer drinkers: Perceptual, attitudinal and behavioral responses underlying craft-style vs. traditional-style flavor preferences. *Food Quality and Preference*, *82*, 103884. https://doi.org/10.1016/j.foodqual.2020.103884

Jaeger, S. R., Xia, Y., Le Blond, M., Beresford, M. K., Hedderley, D. I., & Cardello, A. V. (2019). Supplementing hedonic and sensory consumer research on beer with cognitive and emotional measures, and additional insights via consumer segmentation. *Food Quality and Preference*, *73*, 117–134. https://doi.org/10.1016/j.foodqual.2018.11.015

Johnson, T. E., Hasted, A., Ristic, R., & Bastian, S. E. (2013). Multidimensional scaling (MDS), cluster and descriptive analyses provide preliminary insights into Australian Shiraz wine regional characteristics. *Food Quality and Preference*, *29*(2), 174–185. https://doi.org/10.1016/j.foodqual.2013.03.010

Josse, J., Pagès, J., & Husson, F. (2008). Testing the significance of the RV coefficient. *Computational Statistics & Data Analysis*, *53*(1), 82–91. https://doi.org/10.1016/j.csda.2008.06.012

Jung, H., Lee, S.-J., Lim, J. H., Kim, B. K., & Park, K. J. (2014). Chemical and sensory profiles of makgeolli, Korean commercial rice wine, from descriptive, chemical, and volatile compound analyses. *Food Chemistry*, *152*, 624–632. https://doi.org/10.1016/j.foodchem.2013.11.127

Kennedy, J. (2010). Evaluation of replicated projective mapping of granola bars. *Journal of Sensory Studies*, *25*(5), 672–684. https://doi.org/10.1111/j.1745-459X.2010.00302.x

Kim, M.-R., Kim, K.-P., & Chung, S.-J. (2019). Utilizing hedonic frame for projective mapping: A case study with Korean fermented soybean

paste soup. *Food Quality and Preference*, *71*, 279–285. https://doi.org/10.1016/j.foodqual.2018.07.014
Kuehn, K. M., & Parker, S. (2021). One of the blokes: Brewsters, branding and gender (in) visibility in New Zealand's craft beer industry. *Journal of Consumer Culture*, *21*(3), 519–538. https://doi.org/10.1177/1469540518806956
Kuijken, B., Gemser, G., & Wijnberg, N. M. (2017). Categorization and willingness to pay for new products: The role of category cues as value anchors. *Journal of Product Innovation Management*, *34*(6), 757–771. https://doi.org/10.1111/jpim.12414
Kukutai, T., & Callister, P. (2009). A "main" ethnic group? Ethnic self-prioritisation among New Zealand youth. *Social Policy Journal of New Zealand*, *36*, 16–31.
Kustos, M., Gambetta, J. M., Jeffery, D. W., Heymann, H., Goodman, S., & Bastian, S. E. (2020). A matter of place: Sensory and chemical characterisation of fine Australian Chardonnay and Shiraz wines of provenance. *Food Research International*, *130*, 108903. https://doi.org/10.1016/j.foodres.2019.108903
Kwak, H. S., Ahn, B. H., Kim, H. R., & Lee, S. Y. (2015). Identification of sensory attributes that drive the likeability of Korean rice wines by American panelists. *Journal of Food Science*, *80*(1), S161–S170. https://doi.org/10.1111/1750-3841.12739
Law, R. (1997). Masculinity, place, and beer advertising in New Zealand: The Southern Man campaign. *New Zealand Geographer*, *53*(2), 22–28. https://doi.org/10.1111/j.1745-7939.1997.tb00495.x
Lawless, H. T., & Glatter, S. (1990). Consistency of multidimensional scaling models derived from odor sorting. *Journal of Sensory Studies*, *5*(4), 217–230. https://doi.org/10.1111/j.1745-459X.1990.tb00492.x
Lê, S., Josse, J., & Husson, F. (2008). FactoMineR: An R package for multivariate analysis. *Journal of Statistical Software*, *25*, 1–18. https://doi.org/10.18637/jss.v025.i01
Lee, S., Kwak, H. S., Kim, S. S., & Lee, Y. (2021). Combination of the check-all-that-apply (CATA) method and just-about-right (JAR) scale to evaluate Korean traditional rice wine (Yakju). *Foods*, *10*(8), 1895. https://doi.org/10.3390/foods10081895
Legras, J.-L., Merdinoglu, D., Cornuet, J.-M., & Karst, F. (2007). Bread, beer and wine: Saccharomyces cerevisiae diversity reflects human history. *Molecular Ecology*, *16*(10), 2091–2102. https://doi.org/10.1111/j.1365-294X.2007.03266.x
Lelièvre, M., Chollet, S., Abdi, H., & Valentin, D. (2008). What is the validity of the sorting task for describing beers? A study using trained and untrained assessors. *Food Quality and Preference*, *19*(8), 697–703. https://doi.org/10.1016/j.foodqual.2008.05.001
Lezaeta, A., Bordeu, E., Næs, T., & Varela, P. (2017). Exploration of consumer perception of Sauvignon Blanc wines with enhanced aroma properties using two different descriptive methods. *Food Research International*, *99*, 186–197. https://doi.org/10.1016/j.foodres.2017.05.003
Louw, L., Malherbe, S., Naes, T., Lambrechts, M., van Rensburg, P., & Nieuwoudt, H. (2013). Validation of two Napping® techniques as rapid sensory screening tools for high alcohol products. *Food Quality and Preference*, *30*(2), 192–201. https://doi.org/10.1016/j.foodqual.2013.05.016
Lucas, C., Iobbi, A., de Matos, A. D., & Tomasino, E. (2023). Understanding the relationship between tropical fruit aroma, acceptance, and emotional response in chardonnay wines. *Food Research International*, *174*, 113496. https://doi.org/10.1016/j.foodres.2023.113496
Luo, Y., Kong, L., Xue, R., Wang, W., & Xia, X. (2020). Bitterness in alcoholic beverages: The profiles of perception, constituents, and contributors. *Trends in Food Science & Technology*, *96*, 222–232. https://doi.org/10.1016/j.tifs.2019.12.026
Maeda, Y., Okuda, M., Hashizume, K., Joyo, M., Mikami, S., & Goto-Yamamoto, N. (2011). Analyses of peptides in sake mash: Forming a profile of bitter-tasting peptides. *Journal of Bioscience and Bioengineering*, *112*(3), 238–246. https://doi.org/10.1016/j.jbiosc.2011.05.006
Mervis, C. B., & Rosch, E. (1981). Categorization of natural objects. *Annual Review of Psychology*, *32*(1), 89–115. https://doi.org/10.1146/annurev.ps.32.020181.000513
Mogilner, C., Rudnick, T., & Iyengar, S. S. (2008). The mere categorization effect: How the presence of categories increases choosers' perceptions of assortment variety and outcome satisfaction. *Journal of Consumer Research*, *35*(2), 202–215. https://doi.org/10.1086/588698
Mouret, M., Monaco, G. L., Urdapilleta, I., & Parr, W. V. (2013). Social representations of wine and culture: A comparison between France and New Zealand. *Food Quality and Preference*, *30*(2), 102–107. https://doi.org/10.1016/j.foodqual.2013.04.014
Murray, W. E., & Overton, J. (2016). Fictive clusters: Crafty strategies in the New Zealand beer industry. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, *70*(3), 176–189. https://doi.org/10.1080/00291951.2016.1177587
Nestrud, M. A., & Lawless, H. T. (2008). Perceptual mapping of citrus juices using projective mapping and profiling data from culinary professionals and consumers. *Food Quality and Preference*, *19*(4), 431–438. https://doi.org/10.1016/j.foodqual.2008.01.001
Oladokun, O., Tarrega, A., James, S., Smart, K., Hort, J., & Cook, D. (2016). The impact of hop bitter acid and polyphenol profiles on the perceived bitterness of beer. *Food Chemistry*, *205*, 212–220. https://doi.org/10.1016/j.foodchem.2016.03.023
Ozanne, J. L., Brucks, M., & Grewal, D. (1992). A study of information search behavior during the categorization of new products. *Journal of Consumer Research*, *18*(4), 452–463. https://doi.org/10.1086/209273
Pagès, J., Cadoret, M., & Lê, S. (2010). The sorted napping: a new holistic approach in sensory evaluation. *Journal of Sensory Studies*, *25*(5), 637–658. https://doi.org/10.1111/j.1745-459x.2010.00292.x
Park, H. J., Ko, J. M., Lim, J., & Hong, J. H. (2020). American consumers' perception and acceptance of an ethnic food with strong flavor: A case study of Kimchi with varying levels of red pepper and fish sauce. *Journal of the Science of Food and Agriculture*, *100*(6), 2348–2357. https://doi.org/10.1002/jsfa.10106
Parr, W. V., Green, J. A., White, K. G., & Sherlock, R. R. (2007). The distinctive flavour of New Zealand sauvignon blanc: Sensory characterisation by wine professionals. *Food Quality and Preference*, *18*(6), 849–861. https://doi.org/10.1016/j.foodqual.2007.02.001
Rudnitskaya, A., Nieuwoudt, H. H., Muller, N., Legin, A., Du Toit, M., & Bauer, F. F. (2010). Instrumental measurement of bitter taste in red wine using an electronic tongue. *Analytical and Bioanalytical Chemistry*, *397*, 3051–3060. https://doi.org/10.1007/s00216-010-3885-3
Saldamando, L. D., Antúnez, L., Torres-moreno, M., Giménez, A., & Ares, G. (2015). Reliability of polarized projective mapping with consumers. *Journal of Sensory Studies*, *30*(4), 280–294. https://doi.org/10.1111/joss.12156
Schlich, P., & Guichard, E. (1989). Selection and classification of volatile compounds of apricot using the RV coefficient. *Journal of Agricultural and Food Chemistry*, *37*(1), 142–150. https://doi.org/10.1021/JF00085A034
Styger, G., Prior, B., & Bauer, F. F. (2011). Wine flavor and aroma. *Journal of Industrial Microbiology and Biotechnology*, *38*(9), 1145–1159. https://doi.org/10.1007/s10295-011-1018-4
Sujan, M., & Bettman, J. R. (1989). The effects of brand positioning strategies on consumers' brand and category perceptions: Some insights from schema research. *Journal of Marketing Research*, *26*(4), 454–467. https://doi.org/10.1177/002224378902600407
Teillet, E. (2015a). *Polarized sensory positioning (PSP) as a sensory profiling technique*. Elsevier.
Teillet, E. (2015b). Polarized sensory positioning (PSP) as a sensory profiling technique. In J. Delarue, J. B. Lawlor, & M. Rogeaux (Eds.), *Rapid sensory profiling techniques* (pp. 215–225). Woodhead Publishing.

Teillet, E., Schlich, P., Urbano, C., Cordelle, S., & Guichard, E. (2010). Sensory methodologies and the taste of water. *Food Quality and Preference*, *21*(8), 967–976. https://doi.org/10.1016/j.foodqual.2010.04.012

Thomas, A., & Pickering, G. (2003). Behavioural segmentation: A New Zealand wine market application. *Journal of Wine Research*, *14*(2–3), 127–138. https://doi.org/10.1080/0957126042000300371

Torri, L., Dinnella, C., Recchia, A., Naes, T., Tuorila, H., & Monteleone, E. (2013). Projective mapping for interpreting wine aroma differences as perceived by naïve and experienced assessors. *Food Quality and Preference*, *29*(1), 6–15. https://doi.org/10.1016/j.foodqual.2013.01.006

Valentin, D., Chollet, S., Nestrud, M., & Abdi, H. (2018). Projective mapping & sorting tasks. In S. Kemp, T. Hollowood, & J. Hort (Eds.), *Descriptive Analysis in Sensory Evaluation* (pp. 535–559). John Wiley & Sons Ltd. https://doi.org/10.1002/9781118991657.ch15

Wang, Q. J., & Spence, C. (2019). Drinking through rosé-coloured glasses: Influence of wine colour on the perception of aroma and flavour in wine experts and novices. *Food Research International*, *126*, 108678. https://doi.org/10.1016/j.foodres.2019.108678

Wilson, C., Brand, J., du Toit, W., & Buica, A. (2018). Polarized projective mapping as a rapid sensory analysis method applied to South African Chenin Blanc wines. *LWT*, *92*, 140–146. https://doi.org/10.1016/j.lwt.2018.02.022

Wilson, M. M., & Goddard, R. W. (2004). Creating value in the New Zealand wine industry. *International Journal of Wine Marketing*, *16*(2), 62–73. https://doi.org/10.1108/eb008773

Wong, B., Muchangi, K., Quach, E., Chen, T., Owens, A., Otter, D., Phillips, M., & Kam, R. (2023). Characterisation of Korean rice wine (makgeolli) prepared by different processing methods. *Current Research in Food Science*, *6*, 100420. https://doi.org/10.1016/j.crfs.2022.100420

Wong, B., Owens, A., Phillips, M., & Kam, R. (2023). Identifying sensory attributes of Korean rice wine (makgeolli) using sensory evaluation and chemical analysis. *Journal of Food Science*, *88*, 4247–4261. https://doi.org/10.1111/1750-3841.16762

Yan, H., Chang, E.-C., Chou, T.-J., & Tang, X. (2015). The over-categorization effect: How the number of categorizations influences shoppers' perceptions of variety and satisfaction. *Journal of Business Research*, *68*(3), 631–638. https://doi.org/10.1016/j.jbusres.2014.08.008

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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