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Consumer understanding of beer and wine body: An exploratory study of an ill-defined concept

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ABSTRACT

Body is a key sensory characteristic for beverage acceptability, drinkability and an important consideration when making a purchase decision. Evidence suggests that consumers perceive low-alcohol beverages as lacking body. Despite the significance of body, little is known about consumer's understanding of the term. This paper employed a qualitative approach to gain insights into regular beer and wine consumers' understanding of beer and wine body in the UK. Focus group (FG) and the Free Choice Description (FCD) techniques helped explore the term with frequent beer and wine consumers (n = 90). In contrast with most research within alcoholic beverages which has focused on body perception as a one-dimensional viscosity component, this paper identified other sensory characteristics and compositional factors for both beer and wine that were perceived to contribute to body perception from a consumer perspective. It was evident from the present exploratory study that body constituted several modalities, including flavour, mouthfeel and aroma. Other essential factors for beer and wine body perception included appearance and overall beverage quality. It was also demonstrated that specific flavours, including dark fruit (blackberry, cherry, plum), citrus and tropical fruit flavours, Maillard reaction and cereal, as well as the barrel-age flavours (chocolate, coffee, caramel, smoke, grain, oak, roasted malt) were important for body perception. Mouthfeel attributes, such as velvety, smooth, and creamy, were also perceived to be responsible for body perception in beer and wine. Overall, findings from this study are compared across beverage types to provide direction to researchers and new-product developers on the key factors contributing to body perception from the consumer perspective.

1. Introduction

Body is an essential sensory characteristic of any wine style (Runnebaum, Boulton, Powell, & Heymann, 2011) and wine quality (Jackson, 2017a), and a desirable attribute for reduced calorie/low-alcohol beers (Liguori et al., 2015) that are considered watery, mainly on account of lacking mouthfeel (Malfliet, Goiris, Aerts, & de Cooman, 2009). With the low-alcohol beverage market growing rapidly, body is crucial for the drinkability and acceptability of those products. Although the term body is intermittently used by Australian wine consumers (Niimi, Danner, Li, Bossan, & Bastian, 2017), concerns have been raised regarding conflicting interpretations of the term (Gawel, Van Sluyter, & Waters, 2007; Laguna, Álvarez, Simone, Moreno-Arribas, & Bartolomé, 2019; Vidal, Giménez, Medina, Boido, & Ares, 2015). Previous research associated beverage palate fullness with physical properties such as density and viscosity (Langstaff & Lewis, 1993), non-volatile substances and molar mass fractions in beer (Krebs, Gastl, & Becker, 2021), and an important contribution to the overall tactile perception in wine along with astringency, heat and carbonation (Jackson, 2017a). Numerous studies involving trained panels have defined wine body or fullness as *'viscous mouthfeel'* (Gawel et al., 2007; Laguna et al., 2019; Runnebaum et al., 2011; Skogerson et al., 2009; Vidal et al., 2004) and associated beer body with weight and flow resistance (Langstaff & Lewis, 1993). Currently, beer body is defined as *'fullness of flavour and mouthfeel'* by the American Society of Brewing Chemists (Methods, 2011), including descriptors proposed by Clapperton, Dalgliesh, and Meilgaard (1976), namely thick, satiating, characterless and watery. This definition appears to lack precision of what exactly body constitutes. Furthermore, contradictory findings of ethanol and glycerol contribution to wine body emerged previously (Gawel et al., 2007; Nurgel & Pickering, 2005).

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Others reported the contribution of various polysaccharide fractions to wine fullness (Vidal et al., 2004) and metabolites, such as proline and lactate, to wine body (Skogerson et al., 2009).

Existing research is limited in its focus and primarily explores one-dimensional contributors to body, such as viscosity, density, ethanol and glycerol. Furthermore, studies investigating consumer perceptions of body in alcoholic beverages are, to date, limited to wine (Niimi et al., 2017), with no qualitative studies specifically exploring consumer understanding of body in beer, as well as comparing and contrasting perceptions across beverages. Therefore, it is unclear if the definitions and contributing factors of body found for wine are similar for beer.

Therefore, the objectives of this study were to (i) gain insights into regular beer and wine consumers' understanding of beer and wine body in the UK; (ii) understand consumer perceptions of differences between light-bodied and full-bodied beers and wines using a qualitative approach; and (iii) investigate the relationship between consumer-generated sensory characteristics and body in commercial beers and wines.

2. Materials and Methods

Ethics approval for this study was granted from the University of Nottingham's Medical Ethics Committee (Ref. number: 196-1801). The first two objectives of this study were achieved using focus groups (FGs), whilst the third objective was achieved using the Free Choice Description (FCD) method. Consumers (n=90) participated in two sessions (FG and FCD sessions) over a six week period at the Sensory Science Centre, Sutton Bonington Campus, University of Nottingham.

2.1. Participants

Consumers were invited to participate via an established consumer database consisting of University of Nottingham students, employees and members of the public in the Nottinghamshire (UK) area. Consumers (n=175) responded to the invitation and were further screened to ascertain if they were above the UK legal drinking age (18 years old and above) and determine their beer, red wine and white wine consumption frequencies, self-reported subjective knowledge level and basic demographics, such as age, gender, ethnicity, and occupation. A beverage preference (beer, red wine or white wine) question was asked to assign consumers to a beverage category. Beer (n=30: 20 men, 10 women; aged 20–65; mean age 29.7±11.4), red wine (n=30: 5 men, 25 women; aged 20–52; mean age 29.2±8.1) and white wine consumers (n=30: 3 men, 27 women; aged 19–63; mean age 28.1±11.9), who self-reported consumption of one of the beverages (beer, red or white wine) at least once a month, were invited to participate. Informed consent was obtained from all participants.

2.2. Focus groups

Three alcoholic beverage categories (beer, red wine and white wine) were selected, and 3 FGs for each category were conducted (9 in total for all three beverage categories). Each FG comprised 10 consumers of the same self-reported knowledge level, determined by a previously described method (Flynn & Goldsmith, 1999). Therefore, 3 levels of self-reported subjective knowledge ('less knowledgeable', 'knowledgeable', and 'highly knowledgeable', n=10 in each) were formed, equating to 3 FGs for each beverage category (Fig. 1). This was to ensure that

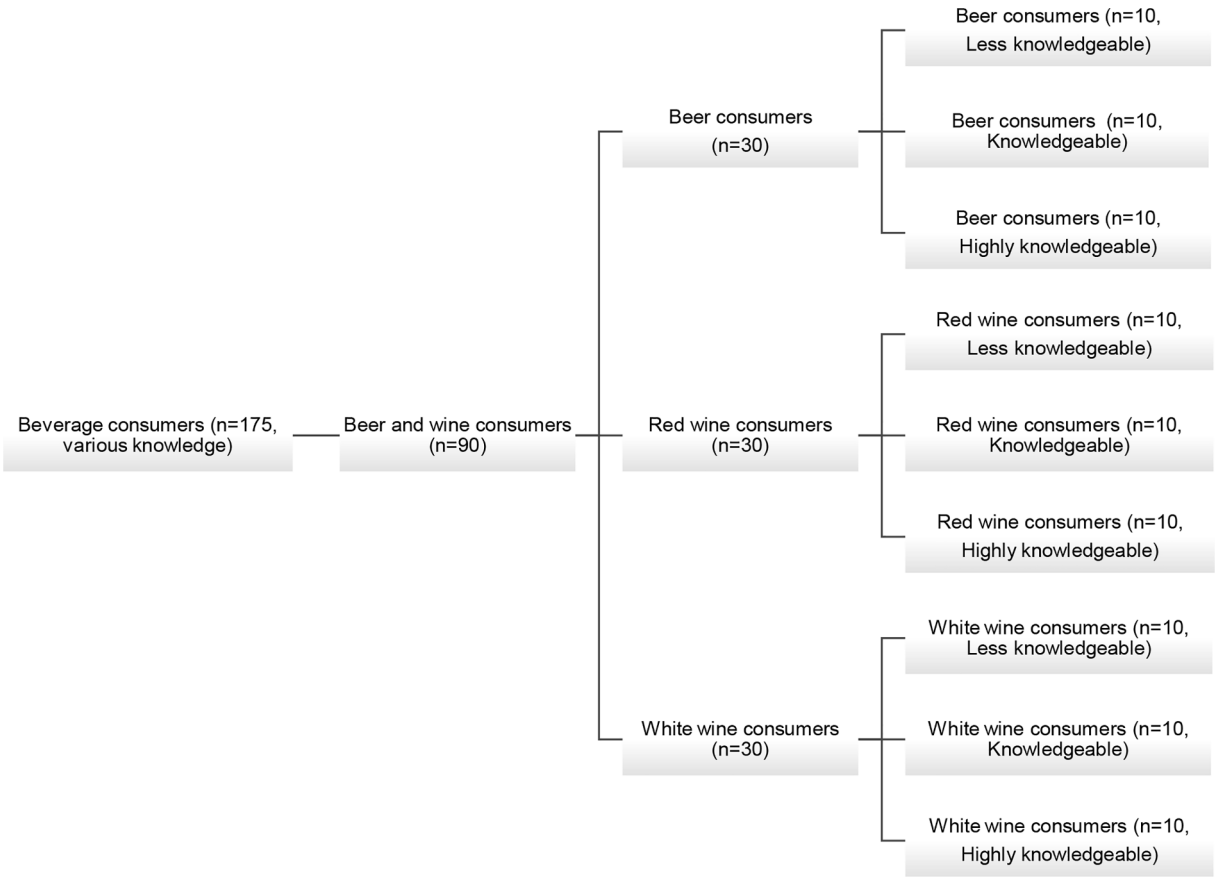

Fig. 1. A pool of screened consumers with various self-reported knowledge levels (n=175), from which beer and wine consumers (n=90) were subdivided into beer (n=30), red wine (n=30) and white wine (n=30) groups, further sub-divided into Focus Groups, according to preferred beverage category and self-reported knowledge level ('less knowledgeable' (n=10), 'knowledgeable' (n=10) and 'highly knowledgeable' (n=10)).

consumers felt comfortable as they would be discussing alcoholic beverage topics amongst people with a similar knowledge level. Each FG interview lasted approximately 1.5h and was held during the daytime.

The FG discussion guide (Table 1) was semi-structured and consisted of open-ended questions that were designed to explore (i) consumer definitions of beer and wine body; and (ii) differences between consumer groups understanding of the term body, vocabulary use and the sensory attributes they associate with this concept. The FGs aimed to consolidate consumers' thoughts, ideas, and beliefs into themes informing and directing further research. The number of FGs per beverage category (3, n=30) ensured data saturation (Guest, Namey, & McKenna, 2017). All FG discussions were audio-recorded. Extensive notes were taken by the principal investigator to ensure that consumer responses were accurately captured and allowed subsequent assessment of the non-verbal cues noted.

2.2.1. Samples

A sample tasting was included within each FG to facilitate the discussions. Consumers communicated their overall impressions of the samples and were then probed for specific attributes related to body. Within each beverage category, a range of either commercial beers (n=5), white (n=3) or red wines (n=3) from the EU and US markets were selected to represent a range of beverage styles (Table 2). The products were chosen to represent a wide range of sensory properties, including varying alcohol content and flavour profiles. Samples (50mL) were served simultaneously in tinted glass vials (100mL, amber), labelled with random 3-digit codes. Consumers were instructed to cleanse their palates between each sample with water (Evian, France) and unsalted crackers (Ruksens, UK). Red wine samples were kept at ambient temperature (18±2 °C), whereas beer and white wine samples were kept in cold storage at 4±2 °C before FGs commenced.

2.3. Free Choice Description

In a separate session, consumers' sensory perceptions of 11 different beers, red and white wines, depending on the consumer's FG assignment, were evaluated using the Free Choice Description (FCD) technique. FCD can be described as a free, spontaneous, idiosyncratic, easy and fast methodology that allows the more salient consumer perceptions of the product to be captured (Buck & Kemp, 2017).

All sessions took place in ISO standard (ISO, 2007) isolated sensory booths with controlled temperature (20 °C), airflow conditions and lighting. Consumers were instructed to taste the samples one by one and spontaneously and freely write down any descriptors or associations they thought applied to or described the body of the beverage they were evaluating, cleansing their palate with water (Evian, France) and unsalted crackers (Ruksens, UK) in between each sample. The consumers were then asked to review their descriptors, add missing terms, or remove redundant words, finalising their response.

2.3.1. Samples

After examining a range of commercial candidate beers and wines from the EU, Australian, US and South American markets, 11 products with a range of flavour and body profiles were selected from each beverage category for consumer testing. Each sample set included an experimental replicate, bringing the overall number of samples evaluated by the consumers in each set to 12 (Table 3). Samples were served monadically in tinted glass vials (100mL, amber), labelled with random 3-digit codes, following the Williams' design presentation order. Serving temperature depended on the products served: i.e. chilled for beers and white wines (7±2 °C) and ambient temperature for red wines (18±2 °C).

2.4. Data analyses

2.4.1. Focus groups

Focus group audio recordings were transcribed. Field notes from

Table 1
Focus group discussion guide.

Event	Description
Opening remarks (5min)	After a short introduction and brief consideration of some housekeeping rules, the principal investigator initiated the discussion, explained the purpose of the study and encouraged participants to express their opinions freely, as well as ask questions and contribute to the debate respectfully.
Warm-up (20min)	The principal investigator showed illustrations and pictures of different scenarios where alcoholic beverages could be consumed, encouraging associative thinking and engagement. Furthermore, the principal investigator asked open-ended questions, such as: **PROMPT:** "Why do you drink beer/wine?" **PROMPT:** "What are your favourite places to have a beverage?" **PROMPT:** "Which beer/wine styles do you normally consume?" **PROMPT:** "What makes them different?" The information provided by the participants was carefully noted and used in later stages if required. In the case of beer groups, supplementary questions were added: **PROMPT:** "What different beers do you enjoy? What makes them different?" **PROMPT:** "What other beverages apart from beer would you normally drink?" *expect mentioning of 'wine' – expand from there **PROMPT:** "What about, for example, 'wine' (mentioned previously) – how do wines differ from each other?" *predicted answers: fullness, complexity, body, region, grape variety **PROBE:** If body was not mentioned for beer – e.g. "I could see some similarities; however, for example, the term body was not mentioned for beer? Why do you think that might be?"
Topic 1: Body of beer/wine (25min)	After the participants mentioned the term body, an open-ended discussion on body definition for the related product was initiated. **PROMPT:** "What is body of beer/wine?" **PROMPT:** "What contributes to body?" **PROBE:** "What about the appearance of the drink?"PROBE: "Are there any mouthfeel/ flavour terms that you can think of that might be important, if any?"
Topic 2: Sensory characteristics/ attributes important to body (30min)	Five blind samples for beer and 3 each for red and white wine were presented to participants in randomised order. Participants were asked to try the samples and make notes on overall characteristics and attributes, including the ones discussed for body earlier. **PROMPT:** "How would you categorise different body styles?" **PROBE:** "Which aromas would you associate with full-bodied drinks? And light-bodied drinks?" **PROBE:** "How does the appearance of those styles of body differ?" **PROBE:** "What texture would you expect of different styles of beer/wine to have?" **PROBE:** "What flavours would you associate with body of an alcoholic drink?" **PROBE:** "What aftertaste would you expect after a light-bodied/full-bodied beer/wine?"
Closing remarks (2min)	The principal investigator closes the sessions by encouraging participants to share any additional opinions or comments and giving thanks.

Table 2
Beer, white wine and red wine samples used to facilitate the Focus Group discussions, including alcoholic degree, production country and description of the beverage sourced either from the commercial label or the company website.

Beverage category			
Beer style	**Alcoholic degree v/v (%)**	**Country**	**Product Description**
Alcohol-Free Lager	<0.05	Germany	Light, crisp, refreshing
Full-Alcohol Lager	4.8	Germany	Golden, classic German-style pilsner with a robust, distinctive full-bodied taste, a fresh hoppy bouquet, distinct bitterness and rich, full head
Wheat Beer	5.3	Germany	Full-bodied, yet elegant character
Stout	4.2	Ireland	Rich and creamy, distinctively black
Bitter	3.6	England	Malty, bittersweet ale with a slight fruitiness and a bitter aftertaste
Red Wines grape variety			
2015 Shiraz	12.5	France	Smooth and fruity red packed with the flavour of ripe damsons and forest fruits, with a hint of bramble on the nose, rich and velvety
2017 Gamay	13.5	France	Complex red with blackcurrant, blueberry and sweet spice flavours, smooth, juicy and silky texture
2015 Zinfandel	14.5	United States	Full-bodied flavours and elegant spice, bold notes of dark cherry and blackberry jam complement hints of mocha and toasted oak
White wines grape variety			
2017 Riesling	9.0	Germany	Medium-dry white packed with zippy citrus, lime and apple flavours, soft and fruity
2017 Sauvignon Blanc	12.5	France	Vibrant aromas of green apple, lime and gooseberry combined with zesty lemon flavours, flavoursome and refreshing
2013 Chardonnay	13.0	France	Full crisp, mineral freshness, pale yellow with a generous nose of nectarine and acacia, citrus and tropical fruit flavours with a long finish

each session were incorporated into the data analysis to identify participant characteristics, involvement, non-verbal cues and enthusiasm levels, subsequently enriching the data. Personal identifiers, names or consumer interactions were removed from the transcripts to ensure consumers' confidentiality. Qualitative data analysis software (nVivo®, SQR International Pty Ltd.) was used to code responses using a coding framework matrix (Framework Method) (Gale, Heath, Cameron, Rashid, & Redwood, 2013) created to identify key insights, followed by the investigation of the narratives with memoing (reading and note-making). Two researchers generated the codes, and any discrepancies were considered. A final coding matrix was discussed with the principal investigator, which provided the opportunity to assess the reliability of the initial coding. Questions (structural nodes in nVivo® terminology) were coded according to the FGs script. Firstly, structural nodes were applied to each transcript to facilitate the extraction of text within specific discussion questions (Oaks, 2001). Furthermore, structural nodes were openly coded, which allowed different beliefs to emerge. This initial coding step had no limitations on the number of codes generated; therefore, the second round of coding (i.e., axial/focused coding) was performed to sort, eliminate, combine, and sub-divide responses to relate the insights to each other. Once the initial analytical framework was developed, transcripts were re-coded, and any new

Table 3
Beer, white wine and red wine samples (depending on consumer group) evaluated by consumers during Free Choice Description sessions.

Beverage **category**			
Beer style	**Alcoholic degree v/v (%)**	**Country**	**Product Description**
*Full-Alcohol Lager (Lager)	4.8	Germany	Golden, classic German-style pilsner with a robust, distinctive full-bodied taste, a fresh hoppy bouquet, distinct bitterness and rich, full head
Alcohol-Free Lager (Lager.LowAlc)	<0.05	Germany	Light, crisp, refreshing
Wheat beer (Wheat)	5.3	Germany	Full-bodied yet elegant character
Low-Alcohol Wheat Beer (Wheat. LowAlc)	0.4	Germany	Refreshing isotonic drink, vitamin-rich
Craft India Pale Ale (Craft.IPA)	5.6	Scotland	Caramel, tropical fruit, grapefruit, pineapple, lychee with a spiky bitter finish
Low-Alcohol Craft Beer (Craft. LowAlc)	0.5	Scotland	Fully fruited hoppy ale, resinous notes, citrus fruit, orange, grapefruit, mango, malt
Craft Red Ale (Craft. Red.Ale)	5.6	England	Full-bodied flavour with subtle cherry and rich fruit overtones
Porter (Porter)	5.0	England	Dark beer with black cherry and plummy aroma, full-bodied, delivering chocolate and prune flavours and a long smoky finish
Pale Ale (Pale.Ale)	4.5	England	Pithy bitterness with a malty backbone, citrus flavours
Bitter (Bitter)	3.6	England	Malty, bittersweet ale with a slight fruitiness and a bitter aftertaste
Stout (Stout)	4.2	Ireland	Rich and creamy, distinctively black
Red Wines grape variety/style			
2017 Merlot Grenache (Merlot. Grenache.FR)	13.5	France	Juicy, easy-drinking and brilliant value wine with strawberry character. The Grenache in the blend adds soft red fruit flavours, and there are hints of chocolate and plum from the Merlot
2017 Gamay (Gamay.FR)	13.5	France	Complex red with blackcurrant, blueberry and sweet spice flavours, smooth, juicy and silky texture
2015 Malbec (Malbec.FR)	13.0	France	Structured, full-bodied yet elegant red made using super-ripe Malbec grapes enriched with a hint of oak. This wine is bursting with blackberry and blackcurrant fruit
2015 Shiraz (Shiraz. FR)	12.5	France	Smooth and fruity red packed with the flavour of ripe damsons and forest fruits, with a hint of bramble on the nose, rich and velvety
2016 Merlot, Cabernet Sauvignon (Merlot. FR)	12.5	France	Structured, full-bodied yet elegant wine which has been enriched with a hint of oak to give layers of black fruit, ripe plum and toasted spice flavours
	13.5	Spain	

(*continued on next page*)

Table 3 (*continued*)

Beverage **category**			
2014 Rioja (Rioja.ES)			Elegant red spicy bramble aromas and concentrated black fruit flavours combined with a long, savoury finish. Aged in oak barrels
2016 Traditional Portugese blend (Portuguese.Blend.PT)	13.0	Portugal	Medium-bodied, red apples and berries
2017 Pinot Noir (Pinot.Noir.DE)	12.5	Germany	Light and fruity, fresh raspberry and strawberry
*2016 Cabernet Sauvignon (Cab.Sav.CL)	13.7	Chile	A smooth, full-bodied Cabernet Sauvignon with cassis and black cherry flavours, complemented by hints of coffee and dark chocolate
2015 Zinfandel (Zinfandel.US)	14.5	California	Full-bodied flavours and elegant spice, bold notes of dark cherry and blackberry jam complement hints of mocha and toasted oak
2014 Merlot (Merlot.US)	13.5	California	Packed with the tempting flavours of blackberry, raspberry and chocolate and is silky smooth
White wines grape variety/style			
2016 Viognier (Viogner.FR)	13.5	France	Elegant aromas of dried fruit, peach and floral notes, with a hint of vanilla, and a satisfying palate balanced perfectly between richness and freshness
2015 Chardonnay (Pouilly-Fuisse.FR)	13.0	France	Rich yet refreshing and mineral scented Chardonnay with ripe peach and pineapple flavours balanced with crisp acidity and a lovely creamy finish
*2016 Chardonnay (Chablis.FR)	12.5	France	Crisp, fresh white rich in quintessential mineral characteristics of Chardonnay from the Chablis region, with great acidity, elegant tones of green apples and citrus flavours accompanied by a long, lingering finish
2016 Sauvignon Blanc (Sav.Blanc.FR)	12.5	France	Refreshing grapefruit and citrus flavours with a crisp finish
2016 Sauvignon Blanc- Sémillon (Sav.Blanc.Sémillon.FR)	12.0	France	Fresh lemony flavours combined with honeysuckle softness. This well-balanced, crisp and aromatic dry white
2016 Albarino (Albarino.ES)	13.0	Spain	Crisp, fresh, aromatic, tropical fruits, peach, grapefruit
2017 Chardonnay (Chardonnay.ES)	12.0	Spain	Fruity citrus honeydew melon flavours and underlying richness and intensity from a classic grape variety
2016 Pinot Grigio (Pinot.Grigio.IT)	12.5	Italy	Elegant and dry, characterised by flavours of peaches, greengages and almonds
2016 Gaglioppo, Cortese (Cortese.IT)	12.5	Italy	The wine is light and fresh, with hints of lemon and grapefruit on the palate and a long, mineral finish
2017 Traditional Portugese Blend (Vihno.Verde.PT)	9.0	Portugal	Zingy white from local grapes, crisp, fresh white
2016 Riesling (Riesling.AU)	12.5	Australia	with citrus and melon notes and a delicate spritz A vibrant, aromatic, fruit-driven Riesling packed full of bold elderflower and green apple notes with a zesty lime finish

Alcoholic degree, production country, and beverage description were sourced either from the commercial label or the company website. Samples marked with the asterisk (*) represent experimental replicate. Sample codes used for Free Choice Description analysis are listed in parentheses. Abbreviations: LowAlc = Low-alcohol, AU = Australia, CL = Chile, DE = Germany, ES = Spain, FR = France, IT = Italy, PT = Portugal, US = United States.

codes and cases that did not fit the existing framework were noted. The initial framework was revised to build a finalised analytical framework, and new and refined codes were incorporated. All transcripts were then coded using the finalised analytical framework. Overarching categories were applied, where appropriate.

Additionally, sub-group responses were coded separately to highlight similar versus contrasting cases between the knowledge-based consumer groups. The data was organised into the framework matrix using Microsoft Excel (Microsoft Corporation, Washington, US), where summarised data was entered by codes (columns) and cased (rows) and transferred into nVivo® work project. A rigorous semantical content analysis (designation, attribution and assertions analyses) (Krippendorff, 2010) was performed to ensure reliability, replicability, and observations' subsequent interpretation. Themes were generated from the data set by reviewing the matrix and making connections within and between participants and categories to interpret the data. The themes were examined with the original research objectives in mind; however, new ideas and concepts generated from the data were also explored. A coding query to extract a word frequency table for each concept was applied. The emerging themes were then brought together based on their similarity, with discrepancies highlighted, where appropriate.

2.4.2. Free Choice Description

The open comments were first transformed into a list of accurate descriptions by correcting the typing and orthographic mistakes and removing connectors and auxiliary terms. Phrases and terms were identified. Frequency tables of terms per beverage (12 beers, 12 red and 12 white wines) were constructed, grouping the synonyms, and eliminating terms mentioned <5% of the time across all beverages. Synonymous and similar words were grouped, e.g., 'sweet', 'sweetness' (grouped as 'Sweet') or 'intense flavour', 'flavoursome', 'full of flavour' (grouped as 'Overall intense flavour'). The frequency of mentions was determined for each final term by counting the number of participants that used each term to describe each beverage. The Chi-Square statistic was used to determine significant terms per beverage category, and Correspondence Analysis (CA) was performed to visualise the contributions. To interpret the dimensions of the CA bi-plot, coordinates of the row/column points and the contribution of the points to inertia were examined. Statistical analyses were performed using XLSTAT (version 2020.5.1, Addinsoft) at a p-value of 0.05. CA bi-plots were constructed and visualised with custom-made scripts in R (R Development Core Team, 2013).

3. Results

3.1. Consumers' understanding of beer and wine body explored with FGs

Consumers most often mentioned flavour attributes when defining body in beer and wine. Mouthfeel, including but not limited to viscosity (thickness and thinness), mouth-coating, smoothness, astringency, and

alcohol warming, were also frequently cited when defining body of all three beverage categories. Aroma and appearance descriptors were also frequently cited; however, some consumers disagreed on appearance and aroma as accurate indicators of beer and wine body. Nevertheless, they stated they were essential factors for initial body perception prior to tasting the product. Key descriptors and concepts are summarised in Table 4.

There was a general consensus across knowledge groups and agreement on the multi-sensory nature of the term. However, a few consumers disagreed with the rest of the group on carbonation contributing to beer's body. Basic tastes, namely bitterness, sweetness, and acidity, were considered to play various roles discussed primarily as characteristics defining body intensity.

Interestingly, consumers either perceived body by (i) flavour and flavour intensity; (ii) mouthfeel and texture; or (iii) a combination of flavour and mouthfeel, amongst other concepts, such as aroma, appearance, carbonation, satiety, and quality.

3.1.1. Beer

Flavour was most discussed by all beer FGs (high frequency of mention), using attributes such as flavour, aftertaste, and flavour intensity. Flavour complexity, flavour carrier, fullness of flavour and juiciness were additionally discussed within the highly knowledgeable beer group (low frequency of mention).

The majority of the consumers mentioned texture concepts, such as smoothness, thickness, carbonation, mouthfeel, creaminess, and alcohol warming. Interestingly, highly knowledgeable groups used technical terms such as astringency, heaviness, density, mouth-coating, viscosity and foaming properties more frequently, whilst other beer groups frequently mentioned fullness.

Other concepts mentioned across the groups were complexity, quality, serving temperature, preference and liking, satiety, expectation, balance, context and enjoyment. Various concepts describing beer characteristics were also frequently cited, including ineffectiveness of flavour, a combination of flavour and mouthfeel, character and distinctiveness.

Table 4
Key descriptors and concepts mentioned by the participants when asked to describe body within the focus groups (including the discussion after sample tasting) Bottom Caption for table 4 ** Frequency of mentions are represented as: low (≤5 mentions, L); medium (6 – 18 mentions, M); and high (19 – 29 mentions, H).

Beverage category	Sensory modality	Key concepts mentioned
Beer	Flavour	flavour [H], aftertaste [H], sweetness [H], bitterness [H], flavour intensity [H], body of flavour [H], flavour complexity [M], flavour carrier [L], fullness of flavour [L], juiciness [L]
	Mouthfeel	smoothness [H], thickness [H], carbonation [H], astringency [H], mouthfeel [M], creaminess [M], alcohol warming [M], heaviness [L], density [L], mouth-coating [L], viscosity [L], foaming properties [L], fullness [L]
	Aroma/ Appearance/ Other	aroma [H], colour [H], appearance [H], aroma intensity [M], complexity [M], quality [M], serving temperature [M], combination [M], preference/ liking [M], satiety [L], character [L], distinctiveness [L], expectation [L], balance [L], context [L], enjoyment [L], ineffectiveness [L], head retention [L], transparency [L]
Red wine	Flavour	flavour [H], aftertaste [VH], body of flavour [H], flavour complexity [M], sweetness [L], flavoursome [L], evolution of taste [L]
	Mouthfeel	mouthfeel [H], astringency [H], alcohol warming [M], smoothness [M], thickness [M], mouth-coating [M], viscosity [L], sharpness [L], hotness [L], trigeminal sensations [L], heaviness [L], creaminess [L], density [L]
	Aroma/ Appearance/ Other	aroma [H], colour [H], appearance [H], context [M], quality [M], serving temperature [M], strength [M], complexity [M], preference/liking [L], combination [L], balance [L], roundness [L]
White wine	Flavour	flavour [H], aftertaste [H], body of flavour [H], flavour intensity [M], sweetness [L]
	Mouthfeel	heaviness [H], mouthfeel [H], astringency [H], alcohol content [M], smoothness [M], thickness [M], sharpness [L], carbonation [L], fullness [L], burning/warming [L], numbing sensation [L]
	Aroma/ Appearance/ Other	aroma [H], colour [H], appearance [M], combination [M], preference/liking [M], multi-factorial [L], quality [L], satiety [L], age [L], crispiness [L], grape variety [L], region [L], winemaking process [L], glass coating [L]

3.1.2. Wine

Wine flavours were most often mentioned as contributing to body and were discussed in detail within the wine FGs. Flavour and aftertaste were amongst the most frequently mentioned attributes across all knowledge groups, followed by body of flavour, flavour complexity, flavour intensity and sweetness.

Mouthfeel and texture attributes were also frequently mentioned for wine body, with the terms mouthfeel, astringency and heaviness most commonly cited by all groups across red and white wine consumers. Furthermore, alcohol warming, smoothness, thickness, and mouth-coating were amongst the most discussed sensory attributes. Interestingly, both knowledgeable and highly knowledgeable groups used technical terms, namely viscosity, sharpness, hotness, carbonation, fullness, and trigeminal sensations, such as warmth, to describe wine body more frequently.

Other concepts that consumers deemed necessary for wine body perception were quality, serving temperature, complexity, preference and liking, balance and roundness. White wine consumers also mentioned the importance of wine age, grape variety, region and winemaking processes when describing wine body. The context was mentioned as a consideration when deciding the appropriateness of full-bodied versus light-bodied wine consumption.

3.2. Consumer understanding of full- and light-bodied beverages explored within FGs

3.2.1. Full-bodied beers

Full-bodied beers were considered more flavoursome, perceptually viscous, astringent, generally being of lower carbonation, or having a different quality of carbonation, namely small, creamy, smooth rather than large, coarse bubbles. Full-bodied beers were also associated with alcohol warming. Creaminess, thickness, and smoothness were related to full-bodied beer texture.

More aromatic beer styles with intense, full, rich, dark fruit and malt flavours (blackberry, cherry, plum, chocolate, coffee, caramel, smoke, grain, oak, roasted malt), and sharp, tangy, tropical fruit flavours, such as orange, lemon and pineapple, were related to full-bodied beers. Umami, bitter taste and hoppy flavour were briefly mentioned as being indicative of fuller body. Also, beer was referred to as full-bodied when the aftertaste persisted and matched the initial flavour. The quality of aftertaste was referred to as *'crucial'*, as beers with an aftertaste that was noticeably different from the initial flavour were considered of poor quality and, therefore, of lower body.

Visually darker and less transparent beer styles were also most commonly associated with fuller beer body. However, several consumers recognised that using visual cues could be deceiving, and they shared experiences where their visual expectations did not meet the reality when tasting beers. An intense aroma was also mentioned as a misleading cue. Therefore, consumers pointed out that flavour and mouthfeel sensations (i.e. flavour intensity, aftertaste, thickness and carbonation properties) play a more significant role in identifying full-bodied beers than overall appearance (such as colour, colour intensity

and transparency) and initial aroma intensity. Foaming properties, precisely the beer head appearance, were mentioned as indicative of fuller body in beer.

Interestingly, two distinct opinions emerged when consumers debated beer quality: (i) consumers either related poor beer quality to light body or (ii) agreed that beer quality and beer body were unrelated concepts. When probed to describe differences in quality (unrelated to consumption), at least half of the consumers from less knowledgeable and knowledgeable groups discussed beer packaging (cans, bottles, kegs) concerning quality, emphasising that beer packaged in glass bottles is perceived to be of higher quality.

Furthermore, associations were made with food pairings and context: consumers agreed that it is more appropriate to have full-bodied beers with heavier meals (i.e. various meats, baked bread) and during a colder season.

3.2.2. Light-bodied beers

Most consumers highlighted the lack of flavour, perceived viscosity (i.e. thinness), and water-like (watery) properties regarding light-bodied beer.

Two distinct perspectives were expressed by consumers when probed on the various flavour of light-bodied beers: (i) beers with lighter body generally lack flavour characteristics entirely (i.e. they exhibit low-intensity flavour initially, limited flavour diversity and absence of any aftertaste); and (ii) light-bodied beers exhibit flavour characteristics such as sharp, crispy, acidic, hoppy in contrast to the flavour profiles of the full-bodied beers. The flavours of lower-alcohol beers were described as empty, ineffective and lacking balance.

Common responses related to the aftertaste of light-bodied beers reflected a belief in contrast to that of beers with fuller body: i.e. the aftertaste of light-bodied beers is mild, instant and does not exhibit complexity, as well as lacks flavour development after swallowing. Consumers also mentioned off-flavours, namely, metallic, as a typical characteristic of light-bodied beers, suggesting poor quality.

Furthermore, a debate around the carbonation level of light-bodied beers emerged in all FGs. High carbonation was generally seen as a characteristic strongly related to beers with lighter body; yet, several discussions supported the idea that low carbonation may correlate with water-like properties in some beers. However, there was a consensus that when combined with perceivably higher viscosity and intense flavour – finer (lower) carbonation may impart the opposite effect, allowing the beer to be perceived as being of fuller body.

Lower alcohol beers also emerged within consumers' conversations as being perceived as light in body, thin and highly carbonated.

3.2.3. Full-bodied wines

Full-bodied red wines were most commonly associated with strong, intense flavours, namely black cherry, blackberry, plum, chocolate, honey, vanilla, caramel, oak, wood, tobacco, mushroom, earthy, spice, cinnamon and leather notes. Full-bodied white wines were possibly related to learned associations of flavours perceptually enhancing sweetness, namely, pear, peach, sweet apple, red berries and ripe cherry.

The lingering aftertaste was strongly associated with full-bodied wines. Flavours that remained in the mouth after swallowing and matched the intensity and complexity of the initial sensory profile, rather than acidic and vinegar-like taste, were considered full-bodied.

Consumers agreed that thicker, smoother, creamier, syrup-, liquor- and velvet-like wines, with substantial mouth-coating properties, would be considered full-bodied. Consumers highlighted astringent and tannic red wines as representative of fuller body; however, the majority agreed that a balance with sweetness is required to achieve the desired full-bodied effect. Astringent and acidic white wines were considered less viscous and lighter in body by most consumers, who suggested that the intensity of sweetness predominantly contributes to the perception of viscosity and, therefore, fuller body. Alcohol warming sensation and sweetness were mentioned as important contributors to the wine body; however, these were less frequently used when describing full-bodied red wines. Interestingly (and similar to findings for white wine), a considerable number of consumers disagreed or expressed two opposing viewpoints whereby red wine is considered full-bodied with increased viscosity if; (i) it is high in sweetness, or (ii) it is highly astringent, dry and low in sweetness.

Red wines of darker red colour were more likely to be considered full-bodied. Similarly, white wines of dark yellow, orange, and gold colours were deemed full-bodied, albeit several consumers disagreed with that statement, suggesting that a paler white wine colour could indicate a fuller body.

Some consumers initiated the debate on quality and its relation to the wine body. Several consumers stated that cheaper, full-bodied, low-quality counterparts lacked balance and roundness in their overall flavour profile compared to expensive, full-bodied, high-quality red wines.

Furthermore, serving temperature was discussed in the context of aroma intensity but was not necessarily related to the body of red wine. Consumers agreed that the appearance of wine, such as a denser coating of the glass and more continual leg distribution, could be indicative of thickness and alcohol content and, therefore, predictive of wine body.

Many conversations emerged regarding context and associative consumption experiences, including the time of day (i.e., consumers considered consumption of full-bodied wines to be more appropriate in the evening), consumption pace (i.e., slower consumption pace was preferable for fuller wines due to their strong, rich and overwhelming flavours), as well as consumption amount (i.e., consumers agreed that relative to the consumption of wine with lighter body, smaller amounts of fuller body wine can be consumed). Some consumers emphasised that a sensation of stomach fullness and a sickly feeling after consuming small quantities of wine may indicate its body.

3.2.4. Light-bodied wines

Regarding the beliefs for light-bodied red wines, consumers of red wine FGs agreed that the absence of complex flavours and a strong alcoholic (ethanol) aroma and flavour, together with a lighter colour and high acidity, gave the strongest correlation with light body perception.

Light-bodied red wines were perceived as watery, diluted, thin, dry, and crisp (sometimes referred to as green flavour). Not all consumers agreed that light-bodied red wines exhibit characteristics, such as dry, astringent, and acidic. Some believed that light-bodied red wines exhibit higher sweetness and red fruit flavours (i.e., strawberry, raspberry, sweet apple). However, some wines have water-like properties similar to grape juice. Light-bodied white wines were mainly perceived as having sharp, crisp, tart attributes and flavours, including green apple, citrus and gooseberry, water-like properties, and low textural presence (thinness). Fewer consumers agreed on the alternative that light-bodied white wines exhibit high sweetness and fruity flavours, namely, lychee, melon, and white peach in combination with absent texture (water-like). Most consumers considered the aftertaste of light-bodied red and white wines weak, instant, harsh, and acidic.

Low quality and rapid winemaking processes, as well as young wines, were associated with light body.

3.3. Consumer understanding of body explored with FCD

3.3.1. Beer samples

Over 250 attributes were collated together, and 37 attributes were identified in total. A significant association between attributes was observed from the Chi-square analysis (p=0.021). CA was performed on all attributes that differentiated the beers, resulting in 49.28% of the data variation explained in the first two dimensions. A contribution bi-plot of the beer samples visualises the scores and loadings from the CA of the sensory data (Fig. 2).

The first dimension (Dimension 1, 29.2%) distinguished beer

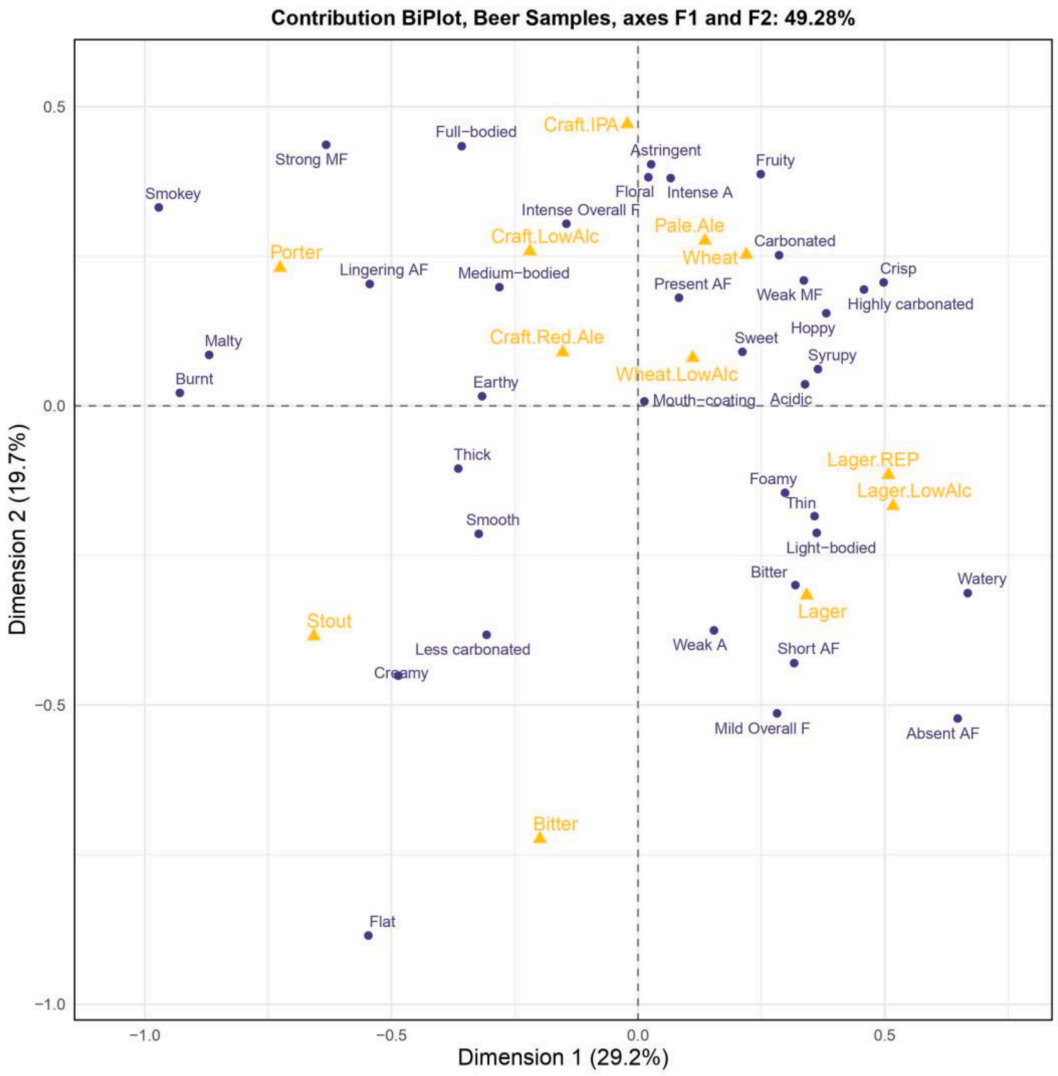

Fig. 2. Correspondence Analysis bi-plot with attributes (●, n=37) present on Dimensions 1 and 2 across commercial beer samples (▲, n = 12). Chi-Square test, p=0.021, showing a significant link between the attributes and the samples. Abbreviations: LowAlc = Low-alcohol, REP = replicate, A = Aroma, F = Flavour, MF = Mouthfeel, AF = Aftertaste.

samples on the right-hand side of the bi-plot, which consumers perceived as light-bodied, watery, thin, bitter, crisp, highly carbonated, hoppy, acidic, with weak mouthfeel, weak aroma, and mild overall flavour, from those on the left-hand side perceived as smoky, burnt, malty, thick, smooth, less carbonated, with intense mouthfeel and lingering aftertaste. The second dimension (Dimension 2, 19.7%) separated beer samples in the top half of the bi-plot that consumers perceived as astringent, floral, fruity, full-bodied, with intense aroma and intense overall flavour from flat, creamy, less carbonated samples, with weak aroma and short aftertaste, positioned in the bottom half.

In the upper quadrants, porter (**Porter**) was mostly perceived as smoky, malty, burnt, with intense mouthfeel and lingering aftertaste. In contrast, craft IPA (**Craft.IPA**), low-alcohol craft beer (**Craft.LowAlc**), and American style craft red ale (**Craft.Red.Ale**) were perceived as full- to medium-bodied and together with pale ale (**Pale.Ale**), wheat (**Wheat**) and low-alcohol wheat beer (**Wheat.LowAlc**) had a stronger correlation with floral, fruity flavours, as well as intense overall flavour, intense aroma, astringent mouthfeel, carbonation and lingering aftertaste.

In the lower right quadrant, two lager replicates (**Lager** and **Lager. REP**) and low-alcohol lager (**Lager.LowAlc**) were distinctly perceived as light-bodied, foamy, thin, bitter, watery, with weak aroma, short or absent aftertaste and mild overall flavour. Whereas, in the lower left quadrant, stout (**Stout**) and bitter (**Bitter**) beers were perceived as flat, creamy, less carbonated, smooth, and thick.

3.3.2. *Red wine samples*

Overall, 257 attributes were obtained. A total of 29 collated attributes were identified to differentiate between the red wine samples. A significant association between attributes and samples was observed (Chi-square test, p=0.023). CA was performed on all attributes, resulting in 58.21% of the data variation explained in the first two dimensions. A contribution bi-plot of the red wine samples shows the scores and loadings from the CA of the sensory data (Fig. 3).

The first dimension (Dimension 1, 43.9%) distinguished red wine samples on the right-hand side of the bi-plot, which consumers perceived as thin, acidic, red fruit-forward, astringent, watery, medium to light-bodied, with mild overall flavour, weak aroma, and short aftertaste, from the left-hand side samples that were perceived as oaky, creamy, thick, smooth, dense, dark fruit-forward, full-bodied, with intense overall flavour and lingering aftertaste. The second dimension (Dimension 2, 14.3%) separated red wine samples in the top half of the bi-plot that consumers perceived as fruity from samples that were more driven by attributes, such as syrupy, light-bodied, and bitter.

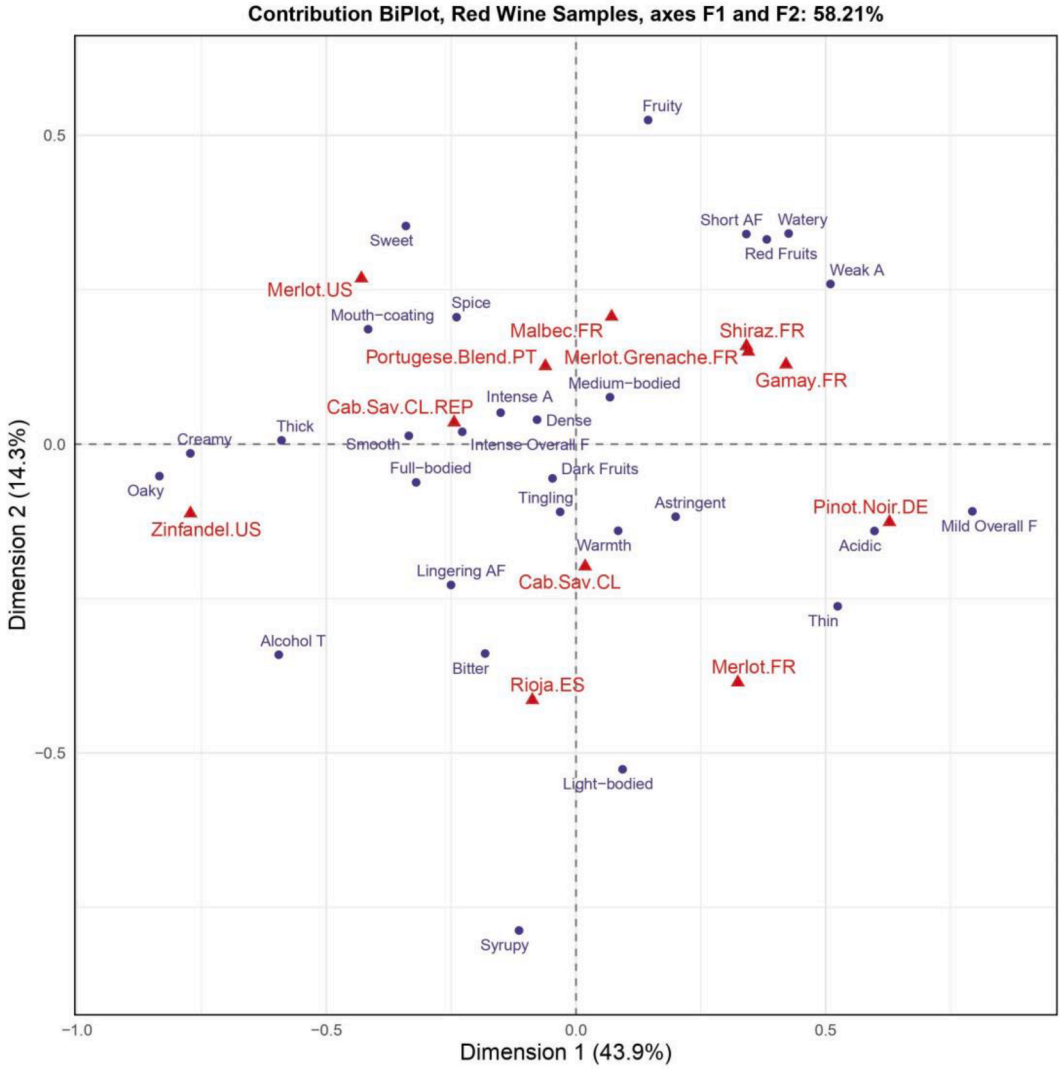

Fig. 3. Correspondence analysis bi-plot with attributes (●, n=29) present on dimensions 1 and 2 across commercial red wine samples (▲, n=12). Chi-Square test, p=0.023, showing a significant link between the attributes and the samples. Abbreviations: REP = replicate, A = Aroma, F = Flavour, MF = Mouthfeel, AF = Aftertaste, AU = Australia, CL = Chile, DE = Germany, ES = Spain, FR = France, IT = Italy, PT = Portugal, US = United States.

In the upper and lower left quadrants, Californian, Chilean and Portugese wines, namely Zinfandel (**Zinfandel.US**), Merlot (**Merlot.US**), Cabernet Sauvignon (**Cab.Sav.CL**), and Portugese blend (**Portugese.Blend.PT**) were perceived by the red wine consumers as oaky, creamy, thick, smooth, mouth-coating, sweet, spicy, full-bodied, with intense aromas, intense overall flavour, lingering aftertaste, and alcohol taste. French wines, namely Malbec (**Malbec.FR**), Merlot-Grenache blend (**Merlot.Grenache.FR**), Shiraz (**Shiraz.FR**) and Gamay (**Gamay.FR**), were mainly perceived as medium-bodied, red fruit-forward, watery, with weak aromas and short aftertaste. In contrast, German Pinot Noir (**Pinot.Noir.DE**) and French Merlot (**Merlot.FR**) were perceived as acidic, thin, and astringent, with mild overall flavour. Finally, Spanish Rioja (**Rioja.ES**) was associated with light body, syrupy and bitter taste.

3.3.3. White wine samples

In total, 22 attributes were generated after the sorting of 211 attributes provided by the consumers. In contrast to beer and red wine samples, the Chi-Square statistic produced a p-value higher than 0.05 (p=0.652); therefore, no significant association between attributes and samples was observed, indicating these samples and attributes were likely independent.

4. Discussion

Similar terms were used for both beer and wine body according to the FG and FCD responses. The consumer mostly understood body by the following characteristics: (i) flavour, taste and aftertaste; (ii) mouthfeel, including viscosity, astringency, alcohol warming, and; (iii) overall aroma and appearance (such as opacity and beverage colour intensity). This highlights body is perceived as a multimodal term by the consumers rather than a one-dimensional viscosity characteristic. Consumers also associated body with quality in both beer and wine.

It was noted that whilst white wine consumers were able to discuss and define body during FGs, the group was unable to discriminate between the white wine samples upon product tasting during the FCD session, suggesting that consumers have difficulty physically distinguishing between white wines of different body styles. Hence, it could be hypothesised that consumers rely on other attributes to describe differences in white wine, such as basic taste intensities and flavour characteristics, rather than multi-dimensional descriptors.

4.1. The influence of flavour on the perceived body in beer and wine

Consumers indicated flavour as the major contributor to wine and

beer body during FGs and FCD. Consumers also indicated light- and full-bodied wines and beers can be distinguished by specific flavours. For both beers and red wines, this was defined by intense dark fruit flavours and cereal-roast notes (malt, smoky, burnt, chocolate, caramel, coffee in beer and oaky, wood, tobacco, spicy in red wine), and tropical fruit flavours for medium-bodied beers, including floral and fruity in FCD. As discussed within FGs, fuller bodied white wines were associated with stone-fruit and red fruit flavours, namely peach, pear, apple, and red berries. This agrees with past literature as flavour (defined as the *wine's fruitiness*) was associated with higher ratings of the perceived body (defined as *'the overall impression of weight or substantiveness of the wine in the mouth'*) in Riesling wines (Gawel et al., 2007) and a key attribute when exploring Australian consumer understanding of wine body (Niimi et al., 2017). Oak flavour was one of the major drivers for body in red wine identified with FCD, which is not surprising as *cis*-oak lactone has been found to contribute to spicy, woody and smoky attributes, which also correlated with the perceived body (Koussissi et al., 2009). Furthermore, previous studies found wine palate fullness associated with dark fruits, jammy flavour, flavour intensity, hotness and sweetness attributes in late harvest Australian Shiraz wines (Li, Bindon, Bastian, Jiranek, & Wilkinson, 2017), and body associated with sweetness, hotness and flavour intensity in early harvest wines (Li, Bindon, Bastian, & Wilkinson, 2018). Similarly, Romero-Medina, Estarrón-Espinosa, Verde-Calvo, Lelièvre-Desmas, and Escalona-Buendiá (2020) found beer palate fullness closely associated with aromas, such as brown sugar, caramel, apple, pineapple, fruity, hoppy, and malty. Beers made with blue corn and barley malts scored higher in fullness than red corn malt (Romero-Medina et al., 2020), highlighting an apparent influence of cereal flavours on body intensity ratings.

Light-bodied beers and wines were associated with lack of flavour, weak aroma and were described as being watery, thin, and acidic, with a short aftertaste. This is not surprising as these attributes are primarily the opposite of those described for full-bodied beer and wines. However, the contribution of acidity is intriguing. Gawel et al. (2014) observed a strong correlation between wine pH and perceived viscosity, where higher pH increased perceived viscosity. Interestingly, Danner et al. (2019) found no correlation between pH, residual sugar and dynamic viscosity measured across red and white wines. This suggests that despite not significantly affecting the typical dynamic viscosity ranges in commercial wines, wine pH and subsequent perceived acidity may play a role in perceived viscosity and wine body. An example of this is the study carried out by Hranilovic et al. (2021), in which bio-acidified Merlot wines scored lower in perceived hotness, bitterness and body.

4.2. The influence of mouthfeel on the perceived body in beer and wine

In this study, consumers used textural terms, such as thickness and viscosity, to describe beer and wine body with or without combining it with flavour and flavour intensity terms during FGs. Attributes such as thick, creamy, and smooth had a stronger correlation to full-bodied wines than beers during FCD, suggesting that texture might be a more substantial contributing factor to body perception in wine.

Inconclusive results were found regarding the relationship between perceived astringency and the perceived body in beers and wines. FCD results highlighted that more astringent beers were associated with fuller body; however, the effect of astringency on body in wine was less clear. FG discussions centred around the impact of sweetness on astringency and body revealed that some consumers identified sweet, high in viscosity and low in astringency wines as full-bodied. Similarly, a reduced rating of astringency was also associated with rhamnogalacturonan II, suggesting an association of fullness with less astringent wines (Vidal et al., 2004). On the contrary, a recent study investigated the influence of mannoprotein supplementation on perceived body and astringency and found no effect on perceived astringency or body in wine (Li et al., 2018), suggesting that other interactions might be at play. Instrumental and sensory work by Gawel et al. (2014) showed higher phenolics positively associated with perceived viscosity; however, wines with higher total phenolics also scored less in astringency/drying in that study, suggesting perceived viscosity correlated with less astringent wines. Furthermore, Laguna et al. (2019) found wine samples with added tannin had the highest instrumentally measured viscosity and were perceived as more astringent, suggesting that this was due to the formation of complexes between the model-wine and salivary proteins. However, no correlation between dynamic viscosity and body (defined as *'viscosity sensation when swishing'*) perception was found, suggesting body perception cannot be explained by viscosity alone.

In contrast to the wine results, consumers perceived astringent beers as more flavoursome, floral, and fuller in body during FCD. Interestingly, a study that defined total mouthfeel in beer as a *'balanced sensation of fewer negative sensations, such as roughness, decreased astringency, and improved positive sensations such as smoothness'*, found the removal of high molecular weight compounds such as bitter compounds, polyphenol, maltodextrin, and free amino nitrogen to yield improved softness, smoothness and decreased astringency (Kato et al., 2021). In contrast, total nitrogen was previously positively correlated with palate fullness in another study (Krebs et al., 2021). This highlights the gap for an accurately defined classification of compositional factors for sensory attributes such as palate fullness, body, and mouthfeel.

During FGs, consumers mentioned alcohol content as a contributor to body perception in both beverages, with lower alcohol beers and wines considered lighter in body. Alcohol taste was also associated with fuller body for red wine during FCD; however, the same finding was not confirmed for beer as alcohol warming was only discussed in the FGs and not provided as a descriptor in the FCD, suggesting that ethanol might have a stronger correlation with body for wine. In contrast with the present findings, ethanol is believed to contribute strongly to beer body (Meilgaard, Dalgliesh, & Clapperton, 1979). It was suggested previously that light-bodied beers lack flavour characteristics compared to full strength beers (Malfliet et al., 2009). It was also reported that ethanol contributes to the complexity of flavour in beer (Clark, Linforth, Bealin-Kelly, & Hort, 2011). Collectively, and, as indicated by the consumers in the present study, this might suggest that despite the low alcohol content, perception of a lighter body might occur mainly due to undesirable alterations to flavour and flavour intensity.

Conflicting evidence is reported by the studies investigating the influence of ethanol on wine body. The addition of ethanol enhanced viscosity perception and decreased astringency in wine by interfering with the hydrogen bonding between proteins and polyphenols (Demiglio & Pickering, 2008; Fontoin, Saucier, Teissedre, & Glories, 2008; Gawel, 1998). This was not consistent with other studies that used a trained sensory panel to evaluate the effect of ethanol on body/viscosity perception, as little to no effect was observed in higher alcohol wines (Pickering, Heatherbell, Vanhanen, & Barnes, 1998). In contrast, another study found that increased ethanol levels affected perceived viscosity and body, as well as hotness. Still, perceived hotness was not an important component of body (Gawel et al., 2007). In a white wine-like model, wine with higher ethanol was found to enhance bitterness, hotness and increase palate dryness; however, no significant effect on perceived viscosity was reported when explored with a trained panel (Jones, Gawel, Francis, & Waters, 2008). Similarly, it was reported that narrow viscosity ranges characteristic of lagers and non-alcoholic alternative beer products result in no significant correlation between viscosity and sensory perception of palate fullness, mouthfeel or sweetness (Krebs, Müller, Becker, & Gastl, 2019), in contrast to the results of the present study. It may be concluded from the previous research that, despite ethanol concentration influencing instrumental density and viscosity, the impact of different ethanol levels on body perception remains unclear.

Neto, de Castilhos, Telis, and Telis-Romero (2015) found a correlation between wine density and viscosity with ethanol levels when measured instrumentally. Consumers in the present study mentioned that density/weight might be correlated with body perception; however,

it appeared quite challenging for the consumers to define these terms. In fact, these terms were mainly used by the highly knowledgeable beverage consumers during FGs, indicating that the majority of consumers may not understand the terms fully. Further research could benefit from exploring contributors of this factor with a trained panel.

In the present study, the beer consumers did not reach a consensus during FGs regarding the importance of carbonation for body perception, irrespective of knowledge level. According to FG discussions, the impact of carbonation appeared to depend on the flavour characteristics, as beers with dark fruit and malt flavours that were less carbonated were perceived to be fuller in body. In contrast, those with more tropical fruit and hoppy flavours that were highly carbonated were perceived to be of medium or lighter body, which the FCD also supported. Beers lacking in flavour and viscosity were perceived to have lighter body but also high carbonation and foaming properties. A comprehensive review by Bamforth (1985) analysed the foaming properties of beer, and compositional factors, such as proteins, polyphenols, glycerol, carbohydrates, namely dextrins and ß-glucans, ethanol and CO_2, that are important for foam formation. It was reported that nitrogenated beers with improved foam stability have less carbonation and enhance smoothness, consistent with the findings from the present study. Previous research reported various effects of compositional factors on carbonation perception and foam formation in beer and sparkling wine (Viejo, Torrico, Dunshea, & Fuentes, 2019); however, research on the impact of those factors on body perception is limited.

4.3. The influence of aroma and appearance on the perceived body in beer and wine

Unsurprisingly, most consumers in the present study associated fuller body with beverages appearing darker. It is well known that visual appearance plays a significant role in perception (Morrot, Brochet, & Dubourdieu, 2001) and influences the drinking experience (Reinoso-Carvalho, Dakduk, Wagemans, & Spence, 2019). Visual appearance cues were previously reported to have an inconsistent influence on perception in beer (Van Doorn, Timora, Watson, Moore, & Spence, 2019). Furthermore, aroma was indicated to influence consumer expectations, subsequently influencing body perception. In contrast, previous research found no effect of aroma on palate sensations and mouthfeel perception in red wine (Sáenz-Navajas, Ferrero-del-Teso, Jeffery, Ferreira, & Fernández-Zurbano, 2020). In white wine, it was reported that volatile fractions play a role for some mouthfeel terms (Sereni, Osborne, & Tomasino, 2016). Hop aroma was reported previously to modify perceived bitterness by taste-aroma interactions in beer (Oladokun et al., 2016); however, influence on mouthfeel is less understood.

4.4. Relating preference to the perceived body

This study showed that some consumers relate body to abstract concepts, including a strong link between body perception and personal preference. When exploring the idea, consumers who stated they preferred more flavoursome beers and wines were more inclined to associate body with flavour. This notion can be explained by the contribution of sensory attribute liking to overall liking. Moskowitz and Krieger (1995) tested several food categories, and the relative importance of sensory inputs was identified as flavour/taste, followed by texture and appearance. However, when looking at individual responses, substantial differences were found in sensory liking inputs driving overall liking (Moskowitz & Krieger, 1995). It was noted, based on the individual responses in the present study, that the consumers who were more reactive to flavour or texture as the main driver for overall liking gravitated towards statements where flavour or texture, respectively, was the central concept in defining body perception. Further research could benefit from investigating the impact of modified body in beer and wine on consumers' hedonic response.

4.5. Relating quality to perceived body

During the FGs, consumers discussed the relationship between body and perceived beverage quality with a general consensus of a positive relationship. This agrees with previous research where texture and mouthfeel have been considered the major contributors to quality and consumer acceptance and preferences for food and beverages (Guinard & Mazzucchelli, 1996). Balance, volume/body, round/smooth tannins, persistency, and fatty mouthfeel were linked to high-quality perception. In contrast, experts linked excessive astringency, excessive sourness, imbalance, light, short, green, bitterness, and coarse tannins to low quality in wine (Jackson, 2017b). The consumers in the present study suggested that light-bodied products have lower quality; however, not all consumers supported that belief. Consumers considered low-quality beers to have a lighter body; however, low carbonation levels were also linked to medium to full-bodied beer styles in FCD. This suggests that higher carbonation affects quality, but the effect on the perceived body depends on other factors.

5. Conclusion

It is evident from the present exploratory study that body constitutes several modalities, including flavour and mouthfeel. According to the consumers in the UK, other important factors for beer and wine body perception include aroma, appearance and quality. It was demonstrated with FGs and FCD that specific flavours and characteristics are responsible for body perception.

Limitations of the qualitative approach applied in this study include, a chance of participant selection bias due to the consumer convenience sample and possible differences between the resultant consumer groups and general sociodemographic characteristics of the society it represents. This research sought to provide rich and robust qualitative data, explore fundamental consumer understanding of the term body, and gather initial insights into what body might constitute to inform future research.

When exploring factors to increase body perception, technical teams and beverage producers must be aware of the term's multifaceted nature and consider various combinational factors that influence body perception. Consumers are expected to perceive body as a combination of flavour (intensity, balance) and texture (perceived viscosity, trigeminal sensations). However, consumers who communicate a stronger preference for flavoursome beverage products are likely to understand body as a multi-sensory perception of flavour. In contrast, consumers more attentive to the textural properties of a beverage are likely to evaluate body according to the textural stimuli. Despite being important for the initial evaluation of body, aroma and appearance of the beverage might not play a key role in overall body perception for everyone. Depending on consumer beliefs, the perception of quality may be negatively affected for products with lighter body styles, suggesting a substantial difference between communicating the appeal of different body styles to the consumer and what contributes to its perception. In an attempt to define beer and wine body, consumers of beer, red and white wine groups called the investigators' attention to the complexity of the concept. There currently appears to be no agreed position on the conditions for fullness in wine or other alcoholic beverages. Further research could benefit from exploring consumer understanding from other markets and geographical locations, as well as directly measuring the impact of compositional factors within beer and wine on the resulting body.

CRediT authorship contribution statement

Natalja Ivanova: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft. **Qian Yang:** Investigation, Supervision. **Susan E.P. Bastian:** Conceptualization, Methodology, Writing - review & editing, Supervision. **Kerry L. Wilkinson:** Writing -

review & editing, Supervision. **Rebecca Ford:** Conceptualization, Methodology, Writing - review & editing, Supervision.

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