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# Consumer Perception of Cows' Milk and Plant-Based Milk Alternatives: Comparing Aotearoa–New Zealand and Singapore Consumers

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## ABSTRACT

As food provisioning becomes more globalized, a shift to understanding cross-country insights is occurring. This study investigated whether the consumer experience of cows' milk and plant-based milk alternatives (PBMAs) differed between Aotearoa New Zealand (A-NZ) and Singaporean (SG) consumers. Further, as data were collected between two sessions, consumer repeatability across sessions was also explored. Consumers evaluated two cows' milks (high fat and low fat) and five PBMAs (oat, rice, soy, almond, and cashew) products commercially available in both countries. While high-fat cows' milk was liked the most, country-specific liking differences were captured in the PBMA space. SG liked PBMA-related sensory properties that drove disliking and negative emotions. A few exceptions existed if the product was more familiar to consumers of one country than the other. Potential differences in response to PBMAs were noted more than A-NZ. Often, cows' milk evoked positive emotions, and PBMAs evoked neutral/negative emotions. Sensory properties related to dairy milk drove liking and positive emotions, while styles were also observed. SG used the middle range of the liking scale and gave lower rates of CATA citations than A-NZ. This resulted in lower product discrimination, magnitude effects in sensory drivers of liking, and lower numbers of sensory drivers of emotions observed in SG than in A-NZ.

## 1 | Introduction

Global trends in food and beverage show a shift in consumer demand toward plant-based products over animal-based products (Aschemann-Witzel et al. 2020; Onwezen et al. 2021; Zegler 2020), with sustainability, animal ethics, social and cultural aspects, and health identified as some of the key drivers for adopting plant-based diets (Weerawarna et al. 2024). Specifically, for similar reasons, plant-based milk alternatives (PBMAs) are gaining market space over cows' milk in the USA, Europe, Australia, and New Zealand (Euvepro 2019; Jeske et al. 2017; Munekata et al. 2020; Sethi et al. 2016; Singhal et al. 2017; Stewart et al. 2020; Transparency-Market-Research 2019; Vaikma et al. 2021; Wolf et al. 2020). Further, PBMAs appear to be more established and are swiftly moving from niche to mainstream markets in Western countries (Haas et al. 2019). Soy-based food and beverages have formed a part of most Asian diets for many decades (Johnson 1992; Low 2022); however, the rapid

**Practical Applications**

- Variation in consumer experience was primarily captured in the PBMA space.
- Where sensory properties were closer to cows' milk more positive emotions were evoked for PBMAs.
- This is key for PBMA manufacturers to increase consumer acceptability for PBMAs.
- Further, PBMAs could be manufactured targeting markets with an emphasis on food familiarity in specific cultures.
- For consumer researchers, cross-cultural studies need to be comprehensively designed to capture accurate cultural differences with the emphasis and knowledge of response style differences, relevance of lexicons, and with optimal data analysis approaches where applicable.
- Liking responses showed a lack of repeatability across sessions, emphasizing that liking responses could be subject to contrast effects with respect to other samples evaluated in the session.
- However, CATA responses showed higher repeatability across sessions.
- Therefore, consumer CATA responses could be captured across multiple evaluation sessions.
- However, the applicability of liking responses in this context needs further investigation.

growth of soy and other PBMAs, such as oat, is now reported in Asian markets like Singapore (Ho 2022).

PBMAs are derived from seeds, nuts, grains, legumes, or fruits as water extracts of soluble and broken-down plant materials (Jeske et al. 2018; Mäkinen et al. 2016; Sethi et al. 2016). In fact, PBMAs' sensory properties are often characterized by their source ingredient, such as "beany flavors," "bitterness," "darker colors" (Kwok and Niranjan 1995; Vanga and Raghavan 2018; Vaikma et al. 2021; Yuan et al. 2008); or a "chalky" or "gritty" mouthfeel as a result of insoluble suspended larger particles (Aidoo et al. 2010; Durand et al. 2003; Sakthi et al. 2020). "Sweet" and "creamy" flavors in PBMAs drive consumer liking, and "beany off flavors" drive disliking (Moss et al. 2022). Jaeger and Giacalone (2021) showed that nonusers of PBMAs had negative expectations toward the products, which hindered their preference or provoked negative emotions. Generally, the expectation of PBMAs to resemble the sensory properties of cows' milk is often identified as a drawback for consumer acceptance of PBMAs (Cardello et al. 2022; Giacalone et al. 2022; Jaeger, Cardello, et al. 2023; Jaeger, Chheang, et al. 2023; Oduro et al. 2021; Sakthi et al. 2020; Vaikma et al. 2021).

Even among global food trends, country of residence and culture still play a primary role in consumer food choices, attitudes toward food (Rozin 1998), subsequent sensory preferences (Prescott and Bell 1995), acceptance (Jeong and Lee 2021), and affective responses (Lee and Lopetcharat 2017). For example, food familiarity varies between cultures. Familiarity is a multifaceted concept related to consumer product experience and plays a primary role in sensory perception (Jamir et al. 2020), acceptability (Nacef et al. 2019), and liking (Torrico et al. 2019) of foods. Additionally, there are differences in cognitive response styles across cultures (Ares 2018). Differences in participant response styles, independent of the question/content, have been identified (Baumgartner and Steenkamp 2021). Often, participants from individualist vs. collectivist cultures have given extreme responses vs. less extreme responses, respectively (Chen et al. 1995; Clarke 2000; Harzing 2006; Lee et al. 2002). Further, individualists typically adopt an analytical approach, while collectivists take a more holistic approach (Hofstede et al. 2010; Oyserman 2011), purported to result in differences in consumer responses, respectively. Ares (2018) recommended pilot studies prior to actual data collection to ensure similar understanding of the lexicon between cultures if lexicons were translated into different languages. Cross-cultural consumer research needs to be meticulously designed to capture data showing accurate cultural differences, given that understanding cultural perspectives of foods is important for the food industry to succeed in global markets (Goldman 2006; Moskowitz and Krieger 1998).

When consumer responses are collected between multiple sessions, it is important to investigate session effects. CATA is reported to produce repeatable data with consumers in sensory profiling (Jaeger et al. 2013, 2013; Weerawarna et al. 2023) and for emotional responses. However, liking responses could be influenced with respect to other samples evaluated in a session (Zwislocki and Goodman 1980). Notably, cross-cultural aspects concerning the repeatability of consumer sensory and emotion CATA data and liking responses are not well established.

Currently, no comparisons of the sensory drivers of liking and emotional response of Aotearoa New Zealand (A-NZ) and Singaporean (SG) consumers toward PBMAs with respect to cows' milk exist. It is crucial to understand the consumers in both the A-NZ and SG markets since A-NZ exports dairy and alternative products to Asia, with SG serving as the primary gateway to Southeast Asian markets (Retailasia 2024). As dairy is a primary component in the A-NZ diet (Statista 2025) and soy is more customary in the Asian diet (Ho 2022; Johnson 1992; Low 2022), it was hypothesized that cross-cultural differences in consumer response to plant-based alternatives and cows' milk would exist.

This study aimed to investigate consumer response to cows' milk and PBMAs in the general population between A-NZ and SG. Specifically, the main objectives were to compare sensory drivers of liking and emotional response to cows' milk and PBMAs. A secondary objective was to consider the repeatability of data between product evaluation sessions from consumers regarding liking, sensory, and emotional response, and further, if repeatability varied between A-NZ and SG.

## 2 | Methodology

### 2.1 | Ethics Approvals and Participants

In A-NZ, this study was submitted to the Massey University Human Ethics process and was judged to be low risk (Application ID 4000025636). SG ethics approval was obtained from the

Agency for Science, Technology and Research (A*STAR) Human Biomedical Research Office Institutional Review Board, Singapore (Reference Number: 2023-035).

This study was interested in consumer response at the population level. Volunteers who were aged 18–65 years, consumed or were willing to consume cows' milk and plant-based milk-alternatives (PBMAs), were not pregnant or lactating, and were not allergic to the products were selected to participate. The A-NZ consumer panel ($n = 104$) was recruited through the Feast consumer database at Massey University, New Zealand. The SG consumer panel ($n = 118$) was recruited via emails sent to personnel at the research institute. A gift voucher was offered to all participants who completed the study as compensation for their time.

## 2.2 | Products

Two cows' milks and five PBMAs (Table 1) from different plant sources, commercially available in both A-NZ and SG, were selected for this study.

## 2.3 | Product Evaluations

Product evaluations were conducted in the Food Experience and Sensory Testing (Feast) Lab at Massey University for A-NZ participants and the Singapore Institute of Food and Biotechnology Innovation (SIFBI) at A*STAR for SG participants. Samples (5°C ± 1°C) were evaluated in standard sensory booths (ISO 2007) under white lighting with a room temperature of 21°C ± 1°C.

Participants attended two ~1.5 h sessions. The two cows' milk products were repeated between both sessions to investigate data repeatability. The remaining five samples of PBMAs were split and evaluated between the two sessions, meaning participants assessed a total of four or five samples in a session. Products were served according to a balanced randomized design between the sessions.

Participants evaluated three 10 mL sips per product to provide liking, emotional, and sensory responses. Each 10 mL sip of a product was presented in a separate 30 mL cup labeled with a random three-digit code. To minimize carryover effects, participants were instructed to palate cleanse with filtered water and a bite of unsalted cracker (Arnott's water cracker original, Australia) prior to tasting from a cup and take a forced minimum break of 30 s after each 10 mL sip evaluation. A forced minimum break of 60 s was imposed prior to evaluating the next product. The data were collected using Compusense Cloud (Compusense Inc., Guelph, ON, Canada) on iPads. Product evaluation sessions were conducted in English in both countries.

### 2.3.1 | Liking Response

Participants tasted one 10 mL sip of a product and selected their level of sample liking on a 9-point hedonic scale (1—*dislike extremely*, 5—*neither like nor dislike*, and 9—*like extremely*) (Peryam and Pilgrim 1957).

### 2.3.2 | Emotional Responses

The emotion lexicon from Thomson (2016) cited in Cardello et al. (2022) for cows' milk and PBMAs was used in a check-all-that-apply (CATA) (Jaeger et al. 2013, 2013) task to profile emotional response to the products. Example statements with alternatives for each emotion term (Table S1) were developed with the use of Microsoft 365 thesaurus (version 2212). A bench testing session was conducted with Feast and SIFBI lab team members to ensure terms were relevant for the chosen sample set and further verify the conceptual similarity between the cultures (Buil et al. 2012). Participants tasted one 10 mL sip of a product and subsequently selected all emotion terms that were evoked during their product experience. Emotion terms were presented according to a randomized balanced design between participants according to a William Latin Square design to avoid term position and order-related confounding effects and presented in five columns on screen. Emotion term order was, however, fixed, for a given participant for all the product

**TABLE 1** | Products evaluated in the study.

| | Product description on packaging[a] | | | | |
|---|---|---|---|---|---|
| | | Nutritional composition (g per 100 g) | | | |
| Product code | Product name | Fat | Protein | Carbohydrate (sugar) | Energy/kJ |
| CowHF | Anchor blue | 3.4 | 3.3 | 4.8 (4.8) | 263.0 |
| CowLF | Anchor light | 1.5 | 3.5 | 5.0 (5.0) | 200.0 |
| Oat | Sanitarium so good oat no added sugar | 3.1 | 1.0 | 6.0 (2.0) | 239.0 |
| Soy | Alpro barista for professionals soy | 1.9 | 3.3 | 2.7 (2.5) | 177.0 |
| Rice | Vitasoy rice milk unsweetened | 1.2 | 0.3 | 9.5 (5.8) | 213.0 |
| Cashew | Sanitarium so good cashew unsweetened | 1.4 | 0.4 | 0.8 (0.1) | 73.0 |
| Almond | Sanitarium so good almond unsweetened | 1.4 | 0.6 | 0.3 (0.1) | 69.0 |

[a]All products were ultra-high temperature (UHT) processed, unsweetened, and unflavored.

evaluations to facilitate higher operational power (Meyners and Castura 2016).

#### 2.3.3 | Sensory Responses

The sensory lexicon was adapted from Cardello et al. (2022), Vaikma et al. (2021), and Ares et al. (2015), using a bench testing session with Feast and SIFBI lab team members to ensure relevant terms for the sample set that are conceptually similar between the cultures were included in the lexicon (Buil et al. 2012). Participants tasted one 10 mL sip of a product and selected all the sensory terms (Table S2) that described the sensory characteristics of the sample using a CATA task following the same approach as described for emotional response.

### 2.4 | Data Analysis

Statistical analyses were performed using R software, version 4.2.3 (R Core Team 2023) in RStudio (2023.03.0) with $\alpha = 0.05$. Package `dplyr` (Wickham et al. 2020) was used for data handling and `ggplot2` for data visualization. Further specific R packages used for other analyses are detailed in each respective section.

#### 2.4.1 | Repeatability of Data Between Sessions in A-NZ and SG

To ascertain if consumer responses were repeatable between sessions, the relationship between sessions 1 and 2 data from the two replicated cows' milk samples was calculated for A-NZ and SG participants. Liking agreement between sessions was evaluated using Cohen's kappa statistic (Cohen 1960) using package `irr` (Gamer et al. 2019). Spearman correlation coefficients ($\rho$) were calculated between the citation proportions between sessions from emotion and sensory CATA data to determine the consistency of consumer response in these aspects.

#### 2.4.2 | Comparing A-NZ and SG Consumer Response for Liking, Emotional, and Sensory Response

**2.4.2.1 | Liking Responses.** Mean and standard error (SE) of liking for each product was calculated for each country. Cumulative link mixed models (CLMMs) (Agresti 2010) in package `ordinal` (Christensen 2022) were used with *product* and *country* as the fixed effects and *assessor* as the random effect to model liking responses from A-NZ and SG. Analysis of deviance was used to determine whether the *product* and *country* effects on liking were statistically significant. Post hoc comparisons (Tukey HSD, $p < 0.05$) were made for significant main effects.

**2.4.2.2 | Emotional Responses.** Mean citation proportions and observed SE for all emotion terms were calculated for each *product* and *country*.

Correspondence analysis (CA) and subsequent biplots were obtained using packages `FactoMineR` (Le et al. 2008) and `factoextra` (Kassambara and Mundt 2020) to visualize the CATA emotional response space of the products by *country*. A product × emotion contingency matrix was developed (Meyners et al. 2013) for CATA citation proportions, on which CA (Abdi and Béra 2014) was performed. The chi-square distance was obtained to map the biplot of product × emotion terms. Dimensions were retained that enabled the highest variance in the data to be maintained. Positioning of product confidence ellipses (95%) was viewed to determine if product emotional response profiles were differentiated.

Mixed logistic regression was subsequently performed using generalized linear mixed effect (GLME) models with default functions (function = glmer, family = binomial, and link = Logit; Agresti 2018) to model the citation proportions, for *product* and *country* as fixed effects and *assessor* as a random effect, to investigate if *product and country* affected emotion term citation proportions. Analysis of deviance (Agresti 2018) was used to determine statistical significance. Post hoc comparisons (Tukey HSD, $p < 0.05$) were made where significant main effects were identified.

**2.4.2.3 | Sensory Responses.** Mean citation proportions and observed SE for all sensory attributes were calculated for each *product* and *country*. CA and mixed logistic regression via GLME were performed on the sensory responses as described for emotional responses in Section 2.4.2.2.

#### 2.4.3 | Sensory Drivers of Liking and Emotional Response for A-NZ and SG Consumers

**2.4.3.1 | Sensory Drivers of Liking.** Cumulative link models (CLMs) (Agresti 2010) in package `Ordinal` (Christensen 2022) was used with *product*, *country*, and *sensory terms* as factors to model liking responses from both A-NZ and SG data. Analysis of deviance was used to determine whether the main effects were statistically significant for liking.

**2.4.3.2 | Sensory Drivers of Emotions.** Relationships between sensory terms and evoked emotions were investigated using a Random Forest approach (Breiman 2001). The random forest approach (Breiman 2001) is a machine learning technique that creates multiple decision trees "a forest," to make robust predictions or classify data. Each decision tree is built on a random subset of data (bootstrapping). The final prediction is made by aggregating the predictions of all the decision trees in the "forest." Package `randomForest` (Liaw and Wiener 2002) with default functions ($n = 500$ decision trees, the number of features [sensory attributes] at the split of each decision tree [mtry] = 4) was used in this study. Feature importance (importance of the sensory attributes) on predicting emotional responses was extracted as mean decreasing Gini (MDG) values (Breiman 2001; Granitto et al. 2007; Menze et al. 2009), providing relative ranking of the relevance of each feature (sensory attribute) to the model prediction (predicting emotions). Higher MDG values indicate sensory terms that are most important to predict the respective emotion term. A level of 15 MDGs was used to compare the sensory attributes in the top 70% importance rankings across emotions for each country. This level was based on where most separation of feature importance was observed. Model performance

for the Random Forest approach was evaluated based on misclassification rate using receiver operating characteristic (ROC) curves (Gurdian et al. 2021, 2022). The area under the curve (AUC) from an ROC explains overall performance (i.e., discrimination ability of the model among true positives [sensory attributes driving the emotion] and false positives [sensory attributes not driving the emotion]). AUC varies from 0 to 1, with AUC > 0.9 = outstanding, 0.9–0.8 = excellent, 0.8–0.7 = good, and < 0.7 = poor performance (Fawcett 2006).

## 3 | Results

Study participant characteristics are provided in Table S3. Participant profiles between countries were similar; however, the proportion of females was higher in A-NZ (79%) than in SG (55%).

### 3.1 | Repeatability of Data Between Sessions in A-NZ and SG

Of note, liking responses of A-NZ consumers showed only low agreement (Cohen's Kappa = 0.134), and SG consumers showed no agreement (Cohen's Kappa = 0.006) between sessions 1 and 2 for the replicated cows' milk samples. The average of the two sessions was calculated for subsequent analysis, noting that despite a lack of individual assessor repeatability of liking responses between sessions, mean scores and analysis of sensory drivers did not differ between session 1 data vs. averaged session 1 and 2 data. In fact, most discrepancies in liking ratings were between one and two points on the 9-point scale.

Spearman correlations for emotion and sensory CATA data between sessions were, however, high: A-NZ $\rho = 0.952$/SG $\rho = 0.720$ and A-NZ $\rho = 0.859$/SG $\rho = 0.759$, respectively.

### 3.2 | Comparing Product Responses Between A-NZ and SG Consumers

#### 3.2.1 | Liking Responses

Figure 1 shows mean product liking scores and SE by A-NZ and SG consumers. A-NZ used 3 to 7 on the liking scale vs. SG only used a 5–7 range. CLMM and analysis of deviance showed that product liking varied significantly by both product and country (Pr > Chisq:Product < 0.001, Country < 0.001) and country-specific product variations (Pr > Chisq Product:Country < 0.001). CowHF was liked similarly by both countries. However, significant differences in liking were noted in the PBMA space for all products between countries. A-NZ disliked PBMAs more than SG in general. Nevertheless, product discrimination in SG was less than for A-NZ. A-NZ consumers indicated more distinct variation in liking within the plant-based space than SG consumers. Interestingly, Almond and Cashew were given the lowest liking scores in both countries and were differentiated from the highest liking of cows' milk samples.

#### 3.2.2 | Emotional Responses

CA explained 61.92% and 18.57% of the variability in emotional response across *product* and *country* for dimensions 1 and 2, respectively (Figure 2). For both A-NZ and SG, CowHF and CowLF were more associated with "traditional," "genuine," and "comforted" than PBMAs. However, country-specific variations were pronounced within the PBMA space. In A-NZ, Almond was more associated with "bored," "masculine," "uninspired," and "cheap" and Cashew with "irritated" but vice versa for SG. SG associated Oat, Rice, and Soy more with "energized," "classy," "feminine," "inspired," "sophisticated," and "adventurous." A-NZ further discriminated Rice and Soy from Oat,

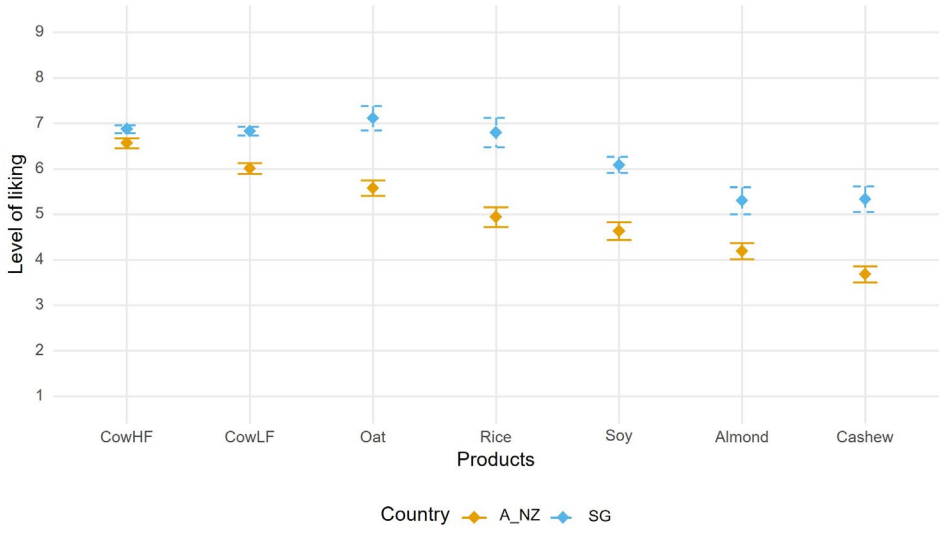


**FIGURE 1** | Mean and SE of liking scores of products by A-NZ (yellow ◆ and continuous line error bars) and SG (blue ◆ and dashed line error bars) consumers. 1—Dislike extremely, 5—Neither like nor dislike, and 9—Like extremely. Different letters "ABCD" (A-NZ) and "ab" (SG) indicate significantly different mean liking scores of products within each country. †Mean product liking scores significantly differ between A-NZ and SG (Tukey HSD, $p < 0.05$).

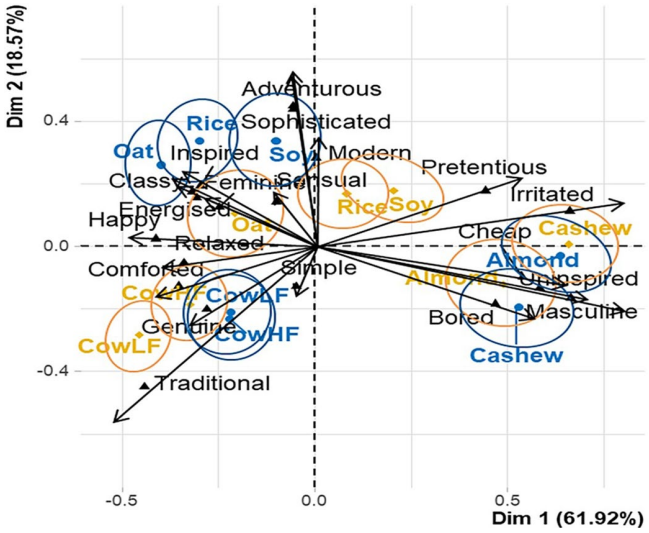


**FIGURE 2** | Biplot of the first two dimensions from CA with 95% confidence ellipses of mean citation proportions of emotion CATA data. Products with ◆ **bold yellow** font for **A-NZ** and ● **bold blue** font for **SG**, and emotion terms with ▲ regular black font.

with the latter product being less associated with "modern" and "pretentious."

Table S4 provides mean CATA citation proportions of emotional terms for each product by country. Analysis of deviance on GLME on mean emotion citation proportions showed a significant *product* effect on all emotions except "feminine" (Table 2), indicating unique product emotional response profiles. For example, post hoc mean comparisons differentiated higher citations for "comforted," "genuine," and "traditional" for the cows' milks than for PBMAs. Within the PBMAs, Almond and Cashew received higher citations for "bored," "cheap," and "irritated" than both cows' milks. Oat, Rice, and Soy also evoked "adventurous" more than the cows' milks. However, Rice and Soy made consumers feel less "relaxed" than cows' milk. A significant *country* effect (Table 2) was also evident in citation differences for "adventurous," "comforted," "genuine," "happy," "inspired," "irritated," "relaxed," "simple," and "traditional." Generally, A-NZ consumers made higher citations than SG consumers (Table S4). Further, there were significant *product: country* interactions for "comforted," "energized," "happy," "inspired," "pretentious," "relaxed," and

**TABLE 2** | Chi-square and Pr(> Chi) values from GLME (product, country, and product:country interaction) on mean citation proportions of emotion CATA terms.

| | Product (df = 6) | | Country (df = 1) | | Product:Country | |
|---|---|---|---|---|---|---|
| **Emotion terms** | **Chi** | **Pr > Chi** | **Chi** | **Pr > Chi** | **Chi** | **Pr > Chi** |
| Adventurous | 72.837 | **< 0.001** | 4.914 | **0.027** | 6.063 | 0.416 |
| Bored | 32.382 | **< 0.001** | 2.009 | 0.156 | 9.993 | 0.125 |
| Cheap | 62.580 | **< 0.001** | 3.413 | 0.065 | 10.842 | 0.093 |
| Classy | 13.200 | **0.040** | 1.052 | 0.305 | 11.619 | 0.071 |
| Comforted | 125.453 | **< 0.001** | 6.509 | **0.011** | 15.914 | **0.014** |
| Energized | 27.646 | **< 0.001** | 2.092 | 0.148 | 16.769 | **0.010** |
| Feminine | 15.825 | 0.105 | 8.682 | 0.122 | 5.550 | 0.475 |
| Genuine | 67.033 | **< 0.001** | 26.309 | **< 0.001** | 6.464 | 0.373 |
| Happy | 85.733 | **< 0.001** | 27.832 | **< 0.001** | 18.385 | **0.005** |
| Inspired | 19.729 | **0.003** | 9.973 | **0.002** | 13.643 | **0.034** |
| Irritated | 114.529 | **< 0.001** | 4.434 | **0.035** | 12.161 | 0.058 |
| Masculine | 18.652 | **0.005** | 0.954 | 0.329 | 4.588 | 0.598 |
| Modern | 34.658 | **< 0.001** | 3.308 | 0.069 | 4.361 | 0.628 |
| Pretentious | 39.612 | **< 0.001** | 0.241 | 0.624 | 14.293 | **0.027** |
| Relaxed | 97.414 | **< 0.001** | 13.150 | **< 0.001** | 21.248 | **0.002** |
| Sensual | 13.032 | **0.043** | 1.568 | 0.211 | 2.201 | 0.900 |
| Simple | 61.010 | **< 0.001** | 7.397 | **0.007** | 3.573 | 0.734 |
| Sophisticated | 27.989 | **< 0.001** | 2.725 | 0.099 | 6.354 | 0.385 |
| Traditional | 177.931 | **< 0.001** | 22.270 | **< 0.001** | 11.632 | 0.071 |
| Uninspired | 102.626 | **< 0.001** | 2.470 | 0.116 | 19.515 | **0.003** |

*Note:* Bold font represents significant Pr(> Chi) < 0.05.

"uninspired" (Table 2), emphasizing that citation for some products was dependent on country. Interactions were mainly due to higher citations for the cows' milk from A-NZ than SG. In contrast, for Rice, "energized" was cited more often by SG than A-NZ consumers. In addition, A-NZ consumers differentiated products more than SG consumers. For example, citation proportions for "genuine" and "pretentious" were differentiated between products in A-NZ but not in SG. "Classy" was an exception that differentiated products by SG, but not in A-NZ consumers.

#### 3.2.3 | Sensory Responses

CA explained 47.28%, 22.23%, and 13.2% of the variability in sensory CATA across *product* and *country* across dimensions 1–3, respectively (Figure 3). Specific country differences regarding sensory product profiles were evident for products. A-NZ most associated cows' milk with "milk-like flavor" but SG with "white appearance." Within the PBMA space, both countries perceived three primary sensory profile groups for products: (1) Almond-Cashew, (2) Soy-Oat, and (3) Rice. A-NZ consumers associated Almond and Cashew more with "bitter," "cardboard-like," and "hay-like" flavors, whereas SG associated them with a "weak/bland" flavor. A-NZ positioned Oat and Soy similarly, but with more "bean-like flavor" than SG. SG discriminated between these two products, characterizing Soy with more "fruity flavor" than Oat, and positioning Oat closer to "beany." Rice was positioned at the origin of dimensions 1 and 2 in both countries, but investigations on dimension 3 (data not shown) showed a high association of "sweet" with Rice by both countries, but higher "rice flavor" by A-NZ than SG consumers.

Table S5 provides the mean sensory CATA citation proportions for each product by country. Analysis of deviance on GLME on mean sensory citation proportions revealed a significant *product* effect on all sensory terms except for "astringency" (Table 3), indicating differing sensory profiles of the products. For example, CowHF was characterized by higher citations of "thick/viscous" texture than CowLF. Further, the cows' milks were differentiated from PBMAs with higher citations for "white appearance," "milk-like flavor," and "creamy mouthfeel." Within the PBMA space, Oat and Soy were given higher citations for "yellow/brown color" than cows' milk and Rice. In addition, there was a significant *country* effect for "sweet," "bitter," "cardboard-like," "grain/wheat," "milk-like flavor," "fruity," "weak/bland flavor," "roasty," "thick/viscous," "thin/watery," and "creamy mouthfeel" sensory terms (Table 3), indicating citation differences between A-NZ and SG. Citation differences between countries were sensory term specific. For example, "sweet" was cited more in general by A-NZ than SG, and vice versa for "thin/watery." Further, there were significant *product:country* interactions for "white appearance," "yellow/brown color," "bitter," "grain/wheat flavor," "milk-like flavor," "nutty flavor," "rice flavor," "fruity flavor," "bean-like flavor," "thin/water," and "creamy mouthfeel" sensory terms (Table 3) emphasizing perceived sensory properties of products further varied by country. The interaction was mainly due to size effect of citation proportion differences, for example, Almond, Cashew, and Rice were given higher citations for "white appearance" by SG than A-NZ, and vice versa for "yellow/brown color" of Almond and Cashew. Additionally, A-NZ differentiated products more on a greater number of sensory terms than SG. SG consumers did not differentiate products on "Salty," "bitter," "metallic," and "cardboard-like" but A-NZ consumers did (Table S5).


**FIGURE 3** | Biplot of the first two dimensions from CA with 95% confidence ellipses of mean citation proportions of sensory CATA data. Products with ◆ **bold yellow** font for **A-NZ** and ● **bold blue** font for **SG**, and sensory terms with ▲ regular font.

### 3.3 | Sensory Drivers Between A-NZ and SG Consumers

#### 3.3.1 | Sensory Drivers of Liking

Table 4 shows the analysis of deviance summary from CLMM on significant sensory drivers of liking. There were some common sensory drivers of liking between both countries. In particular, higher citation of "creamy mouthfeel" was associated with "like extremely" and higher citations of "astringent," "bean-like flavor," "bitter," "earthy," "fruity flavor," "grain/wheat flavor," "metallic," and "oat/cereal flavor" were associated with "dislike moderately" to "dislike extremely" (Figure 4). However, other sensory drivers of liking differed between A-NZ and SG (significant interactions with *country*; Table 4), mainly due to magnitude effects. Higher citations of "milk-like flavor" and "white appearance" were associated with higher levels of liking in both countries; however, the citations from A-NZ were higher than those from SG (Figure 5). Additionally, higher citations for "cardboard-like," "hay-like," and "yellow/brown color" were associated with disliking the products more by A-NZ than for SG. There were significant interactions of *country* on "salty," "sweet," and "weak/bland flavor," however with marginal effects. Regardless of country, "nutty flavor," "rice flavor," "roasty," "thick/viscous," and "thin/watery" had no significant effect on the level of liking.

#### 3.3.2 | Sensory Drivers of Emotions

Table 5 presents the random forest model performance for each emotion for A-NZ and SG. While both countries showed good model performance (AUC > 0.7; Fawcett 2006) on predicting sensory drivers of emotions, A-NZ had a relatively higher AUC

**TABLE 3** | Chi-square and Pr(>Chi) values from GLME (product, country, and product:country interaction) on mean citation proportions of sensory CATA.

| | Product (df = 6) | | Country (df = 1) | | Product:Country | |
|---|---|---|---|---|---|---|
| **Sensory attributes** | **Chi** | **Pr > Chi** | **Chi** | **Pr > Chi** | **Chi** | **Pr > Chi** |
| White appearance | 358.296 | **< 0.001** | 1.309 | 0.253 | 61.363 | **< 0.001** |
| Yellow/brown color | 295.609 | **< 0.001** | 0.558 | 0.455 | 46.206 | **< 0.001** |
| Sweet | 173.690 | **< 0.001** | 7.783 | **0.005** | 7.477 | 0.279 |
| Salty | 15.659 | **0.016** | 0.544 | 0.461 | 5.268 | 0.221 |
| Bitter | 36.581 | **< 0.001** | 5.268 | **0.022** | 14.136 | **0.028** |
| Metallic | 17.970 | **0.006** | 2.547 | 0.111 | 1.869 | 0.931 |
| Cardboard-like | 58.321 | **< 0.001** | 7.269 | **0.007** | 6.624 | 0.357 |
| Grain/wheat flavor | 83.321 | **< 0.001** | 4.604 | **0.032** | 15.838 | **0.015** |
| Milk-like flavor | 316.569 | **< 0.001** | 17.409 | **< 0.001** | 36.562 | **< 0.001** |
| Nutty flavor | 18.236 | **0.006** | 0.621 | 0.431 | 25.554 | **< 0.001** |
| Oaty/cereal flavor | 156.503 | **< 0.001** | 1.144 | 0.285 | 11.946 | 0.063 |
| Rice flavor | 49.041 | **< 0.001** | 0.517 | 0.472 | 13.176 | **0.040** |
| Fruity flavor | 56.307 | **< 0.001** | 17.977 | **0.001** | 17.698 | **0.007** |
| Weak/bland flavor | 116.996 | **< 0.001** | 13.295 | **< 0.001** | 8.420 | 0.209 |
| Bean-like flavor | 111.571 | **< 0.001** | 0.917 | 0.338 | 22.168 | **0.001** |
| Earthy | 54.602 | **< 0.001** | 2.474 | 0.116 | 2.878 | 0.824 |
| Hay-like | 45.602 | **< 0.001** | 1.160 | 0.281 | 11.612 | 0.071 |
| Roasty | 57.235 | **< 0.001** | 5.536 | **0.019** | 4.796 | 0.570 |
| Thick/viscous | 29.531 | **< 0.001** | 6.418 | **0.011** | 9.420 | 0.151 |
| Thin/watery | 87.004 | **< 0.001** | 24.402 | **< 0.001** | 22.730 | **0.001** |
| Creamy mouthfeel | 15,257,120.746 | **< 0.001** | 3,832,063.495 | **< 0.001** | 3,808,521.945 | **< 0.001** |
| Astringent (mouth drying) | 9.972 | 0.126 | 2.327 | 0.127 | 6.435 | 0.376 |

*Note:* Bold font represents significant Pr(>Chi) < 0.05.

(> 0.85) than SG (> 0.73). According to the top 70% feature importance values, "creamy mouthfeel" and "milk-like flavor" evoked "comforted" and "traditional" feelings and "weak/bland flavor" evoked "bored" and "uninspired" feelings in both countries. However, there were some country-specific differences in other sensory drivers of emotions. "Milk-like flavor" only made SG feel "simple." In comparison to SG, other sensory terms drove further emotional responses for A-NZ consumers (Table 5). "Sweet," "thin/watery," and "white appearance" evoked additional positive emotions ("happy," "inspired," and "relaxed"), and "cardboard-like" and "bitter" evoked additional negative emotions ("cheap," "irritated," and "uninspired") for A-NZ. Further, "sweet" made A-NZ feel "uninspired." The remaining emotions, "adventurous," "classy," "energized," "feminine," "modern," "masculine," "pretentious," "sensual," and "sophisticated," were only predicted by the sensory attributes in the lowest 30% feature importance, indicating relatively lower effects of these remaining sensory drivers on these emotional responses.

## 4 | Discussion

This study investigated consumer perception of cows' milk and PBMAs with a focus on determining whether cross-cultural/country differences in perception existed between A-NZ and SG.

Repeatability of sensory and emotional CATA data was high in both A-NZ and SG, confirming previous findings that CATA generates data with within-assessor repeatability when profiling products for sensory (Jaeger et al. 2013, 2013) and emotional (Weerawarna et al. 2023) responses. It also suggests that CATA data on duplicate samples between sessions can be pooled for analysis if required. However, both A-NZ and SG demonstrated low repeatability for liking data between sessions, although not enough to affect the drivers of liking findings. Notably liking was scored on a 9-point scale rather than a binary response, which may also be more subject to variation between sessions. Repeatability of liking data was evaluated only based on the replication of two cows' milk. The

**TABLE 4** | Chi-square and Pr(>Chi) values from CLMM (country, each sensory attribute, and Country: Each sensory attribute interaction) for significant sensory drivers of liking.

| | Chi | Pr(>Chi) |
|---|---|---|
| Country | 305.713 | **<0.001** |
| Astringent | 44.645 | **<0.001** |
| Bean_like_flavor | 28.229 | **<0.001** |
| Bitter | 89.935 | **<0.001** |
| Cardboard_like | 70.900 | **<0.001** |
| Creamy_mouthfeel | 164.383 | **<0.001** |
| Earthy | 10.404 | **0.001** |
| Fruity_flavor | 1.212 | **0.271** |
| Grain_wheat_flavor | 7.107 | **0.008** |
| Hay_like | 29.878 | **<0.001** |
| Metallic | 8.826 | **0.003** |
| Milk_like_flavor | 149.125 | **<0.001** |
| Oaty_cereal_flavor | 11.236 | **0.001** |
| Sweet | 54.824 | **<0.001** |
| Weak_bland_flavor | 62.370 | **<0.001** |
| White_appearance | 8.511 | **0.004** |
| Country:Cardboard_like | 4.443 | **0.035** |
| Country:Hay_like | 4.054 | **0.044** |
| Country:Milk_like_flavor | 4.393 | **0.036** |
| Country:Salty | 12.113 | **0.001** |
| Country:Sweet | 3.973 | **0.046** |
| Country:Weak_bland_flavor | 8.686 | **0.003** |
| Country:White_appearance | 5.792 | **0.016** |
| Country:Yellow_brown_color | 3.766 | **0.052** |

*Note:* Bold font shows Pr(>Chi)<0.05.

liking ratings of the cows' milks between sessions were potentially affected by the nature of the other samples evaluated in their respective sessions, as Zwislocki and Goodman (1980) explained that liking judgments are made relative to the sample set and to the assessor rather than anchoring the liking judgments of each assessor to a common standard. Further research is required to assess consumer repeatability alongside product contrast and scale type effects between evaluation sessions and understand their impact on multi-session studies measuring liking.

Overall, differences in consumer liking, emotional responses, sensory responses, and their sensory drivers of liking and emotions varied by country. SG consumers showed higher liking for PBMAs than A-NZ. For emotional responses, A-NZ cited "comforted" more often for cows' milk and "modern" for Soy. In comparison, SG gave lower citations of "modern" for Soy and higher citations of "energized" for Rice. For sensory responses, A-NZ gave higher citations of "milk-like flavor" for cows' milks than those from SG. A-NZ cited "bean-like flavor," "sweet," and "rice flavor" more often for Soy, Oat, and Rice. The extent of liking scale usage was lower in SG than in A-NZ. Mean liking scores for SG were between 5—"neither like nor dislike" and 7—"like moderately," whereas A-NZ varied from 3—"dislike moderately" to 7—"like moderately" on a 9-point hedonic scale. Additionally, CATA citations were lower overall in SG. Consequently, SG generally had lower product discrimination for liking, emotions and sensory responses, lower numbers of sensory drivers of emotions, and lower model performance in sensory driver predictions. Familiarity (Tuorila et al. 1994; Torrico et al. 2019), collectivism vs. individualism, holistic vs. analytical thinking (Beekman et al. 2022; Beekman and Seo 2022, 2024; Hofstede 2001, 2011; Johnshon et al. 2005; Nisbett et al. 2001), and subsequent differences in response styles (Harzing 2006; Johnshon et al. 2005) are known to impact consumer responses between cultures.

Familiarity with foods decreases uncertainty of expectation and sensory experience and hence increases consumer acceptability and preference (Brogden and Almiron-Roig 2010; Borgogno et al. 2015; Deliza and MacFie 1996; Kim et al. 2015; Kröller et al. 2013; Prescott 1998). Liking for food has a linear relationship with familiarity (Tuorila et al. 1994). Torrico et al. (2019) showed a positive correlation between food familiarity, sensory acceptability and overall liking in Asians and Westerners. Asian-origin foods were more familiar to Asian participants and correlated with higher sensory liking of the products than Western participants, and vice versa. Similarly, Wong et al. (2020) reported that US consumers, who were frequent consumers of fruit chips, gave higher liking scores for fruit chips compared to Korean and Chinese consumers. The present study findings are in line with the literature, in that SG consumers have been familiar with soy-like plant-based flavors in their diet for many years (Johnson 1992; Low 2022) and hence can explain higher liking for PBMAs than A-NZ consumers. Food familiarity has also been related to differences in evoked emotions (Ares 2018; Gerber 1985; van Zyl and Meiselman 2015, 2016), and also between Asian and Western consumers. de Matos et al. (2024) showed that Chinese immigrants in A-NZ felt more "active," "good," "happy," "interested," "joyful," "loving," "pleasant," "satisfied," "secure," and "warm" than A-NZ European consumers when drinking yoghurts with Chinese origin. Similarly, cows' milk is a primary component of the A-NZ diet (Stats-NZ 2025) and explains the higher citations of "comforted" for cows' milks and "modern" for Soy by A-NZ. In comparison, SG are more familiar with soy and rice as components in their traditional diet (Johnson 1992; Low 2022), explaining their lower citations of "modern" for Soy and higher citations of "energized" for Rice.

Familiarity is a complex underlying concept regarding consumer experience of food (Jamir et al. 2020; Jeong and Lee 2021; Nacef et al. 2019; Torrico et al. 2019). Specifically, sensory terms used by consumers are related to cultural and previous product experiences (Antmann et al. 2011; Cherdchu et al. 2013; Hirst et al. 1994; Kim et al. 2018; Munoz and Civille 1998). In fact, even the same sensory stimuli can be perceived differently between cultures/countries. Jamir et al. (2020) showed that American consumers who were frequent cider drinkers used more sensory descriptors in cider evaluation, whereas Chinese

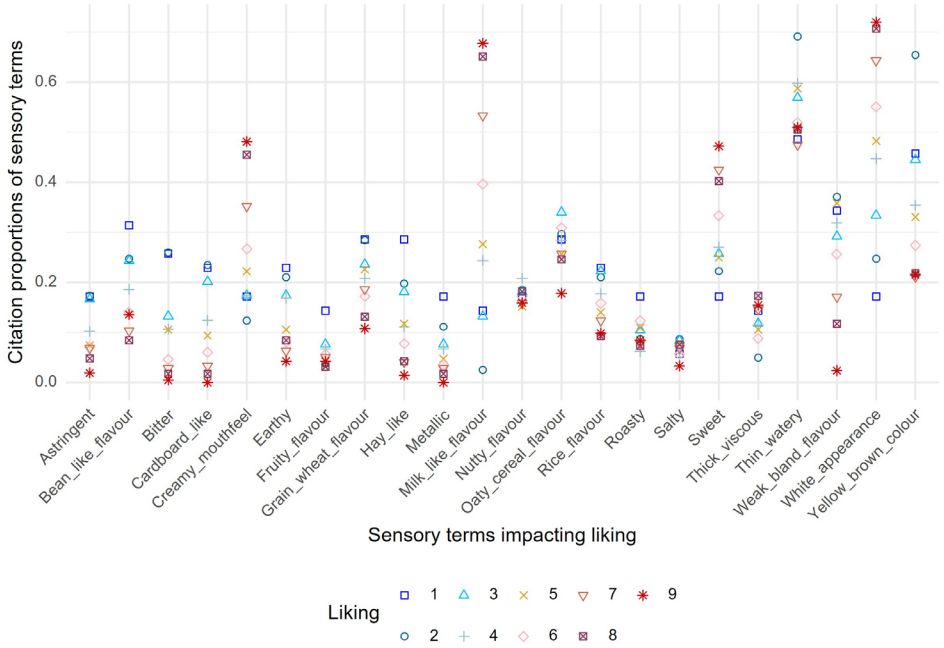


**FIGURE 4** | Plot of citation proportions for sensory terms *significantly* affecting liking (pooled over countries). Levels of liking (1 = Dislike extremely, 5 = Neither like nor dislike, and 9 = Like extremely) are shown by different shapes.

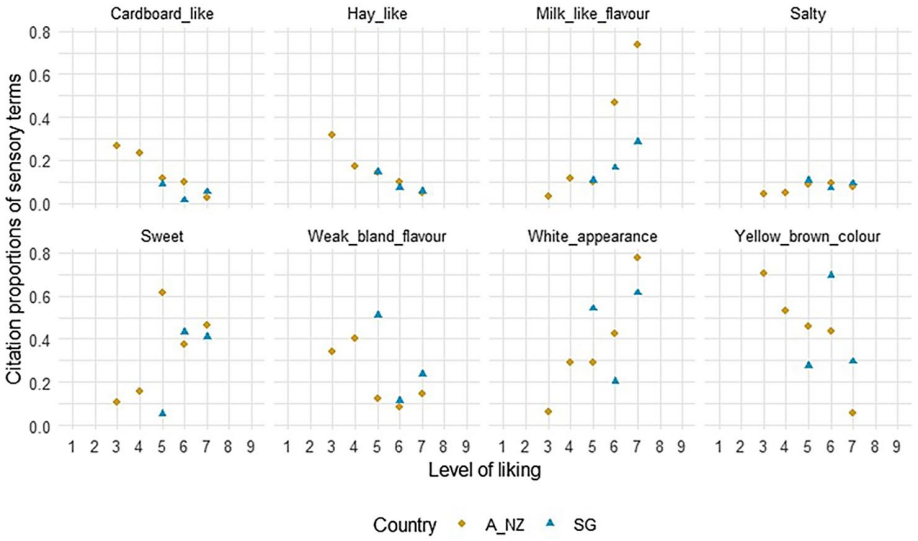


**FIGURE 5** | Plot of citation proportions of sensory terms with significant interactions with *country*. Products are shown by ◆ for A-NZ and ▲ for SG. Level of liking 1 = Dislike extremely, 5 = Neither like nor dislike, and 9 = Like extremely.

consumers only used primary sensory descriptors. Gorman et al. (2021) reported that Canadian consumers who drank coffee with PBMAs better discriminated almond from soy "milk" in coffee compared to those who drank coffee with cows' milk, when evaluated using sensory CATA. In fact, A-NZ's familiarity with cows' milk explains the higher citation of "milk-like flavor" for cows' milks than those from SG. However, A-NZ are relatively more unfamiliar with PBMAs than SG, and yet A-NZ cited "bean-like flavor," "sweet," and "rice flavor" more often for Soy, Oat, and Rice. Lack of familiarity of A-NZ with PBMAs would have created a negative context, and it is postulated that more attention would have been paid to the attribute, resulting in higher citation proportions. Cultural factors other than familiarity would have also contributed to such citation differences between the two countries.

Differences in response styles between Asian and Western consumers also contribute to variations in their responses (Harzing 2006; Johnshon et al. 2005). Previously, researchers have shown cross-cultural scale usage effects (Lee and Lopetcharat 2017; Scholderer 2010) and the tendency of assessors avoiding extreme ends of the 9-point hedonic scale (Hollingworth 1910; Moskowitz 1982; O'Mahony 1982). According to Chen et al. (1995), high school students from Japan and Taiwan used mid-points of 7-point Likert-type scales more than Canadian students. In comparison, USA students used

**TABLE 5** | Model performance (misclassification rate and AUC from ROC curves) and feature importance > 15 mean decrease Gini (MDG) of random forest models of each emotion term by country.

| | Misclassification rate (%) | | AUC from ROC curve | | |
|---|---|---|---|---|---|
| **Emotion** | **A-NZ** | **SG** | **A-NZ** | **SG** | **Sensory terms with feature importance > 15 MDG (= top 70%)** |
| Adventurous | 9 | 5 | 0.91 | 0.96 | NA |
| Bored | 10 | 11 | 0.93 | 0.84 | Weak/bland flavor |
| Cheap | 9 | 9 | 0.94 | 0.87 | Weak/bland flavor, Cardboard-like$^{A\text{-}NZ}$ |
| Classy | 10 | 9 | 0.83 | 0.74 | NA |
| Comforted | 13 | 20 | 0.93 | 0.87 | Creamy mouthfeel, milk-like flavor, sweet$^{A\text{-}NZ}$, thin/watery$^{A\text{-}NZ}$, white appearance$^{A\text{-}NZ}$ |
| Energized | 11 | 13 | 0.92 | 0.79 | NA |
| Feminine | 8 | 6 | 0.85 | 0.74 | NA |
| Genuine | 16 | 12 | 0.92 | 0.73 | Milk-like flavor$^{A\text{-}NZ}$ |
| Happy | 12 | 17 | 0.92 | 0.78 | Creamy mouthfeel$^{A\text{-}NZ}$, milk-like flavor$^{A\text{-}NZ}$, sweet$^{A\text{-}NZ}$ |
| Inspired | 11 | 8 | 0.92 | 0.84 | Sweet$^{A\text{-}NZ}$ |
| Irritated | 7 | 6 | 0.96 | 0.91 | Bitter$^{A\text{-}NZ}$, cardboard-like$^{A\text{-}NZ}$ |
| Masculine | 3 | 2 | 0.91 | 0.90 | NA |
| Modern | 13 | 9 | 0.87 | 0.87 | NA |
| Pretentious | 5 | 6 | 0.95 | 0.94 | NA |
| Relaxed | 17 | 21 | 0.91 | 0.77 | Milk-like flavor, white appearance$^{A\text{-}NZ}$ |
| Sensual | 7 | 6 | 0.90 | 0.81 | NA |
| Simple | 16 | 23 | 0.90 | 0.84 | Milk-like flavor$^{SG}$ |
| Sophisticated | 7 | 8 | 0.88 | 0.85 | NA |
| Traditional | 13 | 18 | 0.93 | 0.89 | Creamy mouthfeel, milk-like flavor, white appearance$^{A\text{-}NZ}$ |
| Uninspired | 10 | 13 | 0.93 | 0.89 | Bitter$^{A\text{-}NZ}$, creamy mouthfeel$^{A\text{-}NZ}$, sweet$^{A\text{-}NZ}$, weak/bland flavor |

*Note:* NA: Feature importance < 15 MDG. Superscripts $^{A\text{-}NZ}$ and $^{SG}$: sensory attributes only relevant to A-NZ or SG, respectively. Sensory attributes without superscripts are relevant to both A-NZ and SG.

extreme ends of the scale more than the former three student groups. These explain SG using the middle portion of the 9-point hedonic scale (5—"neither like nor dislike" to 7—"like moderately") more than A-NZ (3—"dislike moderately" to 7—"like moderately"). Using a limited range of the scale reduces product discrimination ability (Lim and Fujimaru 2010; Schutz and Cardello 2001; Villanueva and Da Silva 2009), which explains the present findings regarding low product discrimination on liking by SG, although it may be that SG simply likes the products similarly. Additionally, both emotion and sensory CATA citations were also lower in SG than in A-NZ. The evidence of A-NZ being more emotionally driven than SG may have other cultural reasons. The individualist culture in A-NZ and hence their analytical approach (Nisbett et al. 2001) could lead to more consideration and use of more CATA terms when responding compared to the more holistic approach of collectivist East Asian cultures (Nisbett et al. 2001) and hence SG citing CATA terms less frequently. As CATA citations are shown to be a proxy for perceived intensity (Jaeger, Cardello, et al. 2023; Jaeger, Chheang, et al. 2023), the analytical mindset of A-NZ may lead to perceiving CATA attributes as more intense and consequently higher citations. However further research is needed to investigate these postulations.

Regarding sensory drivers of both A-NZ and SG, cows' milk-related sensory properties ("creamy mouthfeel," "milk-like flavor," and "white appearance") generally drove positive emotions and liking. In contrast, PBMA related sensory properties ("astringent," "bean-like flavor," "bitter," "earthy," "metallic," "grain/wheat flavor," and "oat/cereal flavor") often drove negative emotions and disliking. Cardello et al. (2022) reported that for A-NZ consumers, "creamy mouthfeel," "milk-like flavor," "sweet," and "white appearance" drove liking in PBMAs whereas "weak/bland flavor," "cardboard-like flavor," "grain/wheat flavor," "rice flavor," and "bean-like flavor" drove disliking, aligning with current findings. Canadian consumers were also in agreement, demonstrating higher liking for "creamy" and "sweet" flavors in PBMAs compared to "beany flavor" (Moss et al. 2022). Generally, the lower a PBMA's sensory profile resemblance to cows' milk, the lower consumer acceptance (Sakthi et al. 2020; Oduro et al. 2021; Vaikma et al. 2021). For yoghurts, Jaeger, Cardello, et al. (2023) and Jaeger, Chheang, et al. (2023)

explained that the incongruency between pre-established sensory expectations of dairy yoghurt and actual sensory experiences of plant-based yoghurt as the primary cause for activation of negative emotions and consequent low acceptability or rejection of the plant-based product. Overall, unsatisfactory sensory quality of plant-based alternatives for animal-based counterparts is reported as the primary drawback for low consumer preference (Fiorentini et al. 2020; Jaeger, Cardello, et al. 2023; Jaeger, Chheang, et al. 2023; McBey et al. 2019; Mycek 2018). Keast and Lau (2006) showed soy "milks" manufactured in Australia were stronger in "milky flavor" (bovine-milk-like) and less intense in "beany" and "sweet" flavors than Singaporean or Malaysian soy "milks." It is evident the soy beverages used by Keast and Lau (2006) were formulated to cater to the market specifics. However, in the present study both A-NZ and SG evaluated the same sample set commercially available in both countries and thus captured the true differences in sensory responses with respect to the cultural (A-NZ vs. SG) context. Cows' milks and PBMAs used in this study were unflavored and unsweetened and would not necessarily have represented actual product usage/application by the consumers. According to Jaeger and Giacalone (2021), a comparison of users and nonusers of PBMA products in the USA showed a clear contribution of situational appropriateness on consumer acceptance of PBMAs. Nonuser groups had lower negative expectations for their use in iced coffee or fruit smoothies with respect to PBMA consumption on its own. Therefore, future studies should explore whether sensory drivers of PBMAs vary with respect to different applications, specifically if the applications differ between cultures/consumer segments.

Measuring liking between sessions might not be optimal as liking responses may be affected with respect to other samples evaluated in the session. In fact, alternatives to scales, such as ranking, could be used for capturing liking responses. If liking scales are used, the data could be standardized to avoid any response style differences; however, with emphasis on avoiding over smoothing data and enabling the capture of true cultural differences in liking. While CATA captures explicit emotional responses, it is susceptible to unconscious biases, not limited to cultural aspects. Capturing emotional responses using implicit approaches (Weerawarna et al. 2023) may perhaps mitigate this issue and provide more accurate results.

The objective of this study was to evaluate consumer response at a country level, but a potential limitation could be the difference in gender distribution across each country. However, contrary to research indicating that females may be more accepting of plant-based milk-alternatives (Martínez-Padilla et al. 2023; Pienwisetkaew et al. 2022), Aotearoa-New Zealand consumers liked the plant-based alternatives less, despite their higher female composition.

## 5 | Conclusions

Consumer responses for PBMAs differed from cows' milk with respect to the country. Specifically, the variations in liking were evident in the PBMAs space, where SG consumers showed a stronger liking for PBMAs compared to A-NZ. A-NZ consumers linked cows' milk with comfort and Soy with modernity, whereas SG consumers associated Rice with energy. Sensory responses revealed that A-NZ participants considered cows' milk to be more "milk-like" and could distinguish the unique flavors in Soy, Oat, and Rice. In contrast, SG participants demonstrated less ability to discriminate between these products. Generally, cows' milk-related attributes drove liking and positive emotions for the products in both A-NZ and SG. However, country-specific differences in sensory drivers of liking and emotions were observed. The differences primarily in magnitude effects, could be a result of product familiarity and/or response style differences between A-NZ and SG. SG only used the middle portion of the 9-point liking scale and a lower rate of CATA citations causing less product discrimination and model performance in data analysis, than A-NZ. Overall, SG data were less repeatable than A-NZ data. Regardless of the country, liking data had lower repeatability between sessions, while CATA data were consistent between sessions.


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### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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## Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Emotion lexicon and example synonyms used in the CATA task. **Table S2:** Sensory lexicon and descriptions used in the CATA task. **Table S3:** Characteristics of assessors completed the study. **Table S4:** Mean citation proportions and standard error (SE) of emotion CATA terms by *product* for each *country*. **Table S5:** Mean citation proportions and standard error (SE) of sensory attributes by product for each country.