Exploring consumer perceptions of composite plant-based beverages formulated with neglected and underutilized crops

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HIGHLIGHTS

- Plant-based beverage blends were formulated with neglected and underutilized crops.
- Blends of oat, faba bean, and buckwheat received slightly favourable liking scores.
- Sensory properties of blends still drive acceptance on top of information provided.
- Feelings of novelty, surprise, and humour were linked to the preferable blends.
- Possible protein fortification ingredients are neglected and underutilised crops.

ABSTRACT

The growing interest in plant-based beverages highlights the need for improving the nutritional and sensory qualities of these products in relation to conventional beverages. To enhance the acceptance and appeal of plant-based beverages, blending different plant ingredients is a promising strategy. However, further exploration is necessary to identify sensory properties that drive consumer acceptance of plant-based beverages blended with alternative ingredients. This study examined the sensory properties of fortified conventional oat beverages using the case of underutilized crops. Through a multi-country sensory evaluation study (Belgium, Italy, Serbia, Spain; n = 371), four beverage blends based on oat, faba bean, buckwheat, and lupin, were tested under blind and informed conditions. For all the beverages, participants' hedonic liking was measured, and perceived beverage properties and their emotional responses were scoped through CATA tasks. Results showed that blends of oat, faba bean and buckwheat were rated similarly or slightly higher than the single-ingredient oat beverage. In contrast, the oat and lupin blend received lower ratings. Informing consumers about the underutilized crops used generally increased acceptance, but this effect varied by age and product type. In addition, consumers associated positive emotions such as surprise, humour and novelty with the more appreciated beverages. Finally, these findings highlight the potential of combining underutilized crops in beverage blends, while also underlining the need for careful ingredient selection and further exploration of crop combinations.

Keywords: Plant-based drink, Fortification, Formulations, Emoji, Minor Crops, Liking

1. INTRODUCTION

In response to the calls for sustainable food consumption, plant-based alternatives have gained prominence (GFI, 2021; Prakash et al., 2023). In particular, plant-based beverages have seen varying growth trajectories within the broader plant-based sector, primarily as substitutes for animal-derived products (GMI, 2025; Nielsen, 2024). Generally, these beverages are derived from cereals or nuts, such as oat, rice, almonds, etc., through various processing techniques (Silva et al., 2022). At present, the current array of plant-based beverages available in the market cover a large scope, as driven by innovations in the types and formulations of beverages available (Khemiri & Raymundo, 2024).

Historically, such products were developed as alternatives for individuals with dietary restrictions such as lactose intolerance, or those following vegan lifestyles. However, while these beverages are not new to the market, they have gained renewed attention due to increasing concerns about sustainability (Appiani et al., 2023; Moss et al., 2022). For instance, these alternative beverages are gaining more traction due to their reported lower environmental impacts compared to conventional, animal-sourced beverages. While the exact extent of environmental benefits is still debated (Berardy et al., 2022; Khanpit et al., 2024), these beverages are generally associated with reduced greenhouse gas emissions and land use. National dietary guidelines increasingly encourage the inclusion of plant-based options, supporting their growing presence in commercial markets (Klapp et al., 2022).

In Europe, the consumption of these plant-based beverages has been largely expanding, in light of both health and environmental consumption issues, notwithstanding consumer concerns on price, taste, and variety (GFI, 2025; Hansen et al., 2023). In the same vein, previous literature has explored consumer preferences for these products (Bocker & Silva, 2022; Silva et al., 2022). For example, prior consumer studies have demonstrated what potential drivers and contextual factors can impact an individual's propensity to consume these beverages, starting from food choice preferences, labelling influences, and so on (Appiani et al., 2023; Moss et al., 2022; Su et al., 2024). From a sensory perspective, plant-based beverages provide unique sensory profiles, offering diverse consumption experiences to consumers (Alsado et al., 2025). However, issues remain as to the improvement of the sensory properties of these beverages as some plant-based beverages have been noted for off-flavours and aromas or even unpleasant textures and mouthfeel (Jaeger et al., 2024).

Aside from these potential avenues for improving the quality of plant-based beverages, certain aspects remain unexplored (Khemiri & Raymundo, 2024). Most commercially available beverages rely on single-source ingredients, such as soy, oat, or almond, with known differences in sensory and nutritional profiles (Aydar et al., 2020; Moss et al., 2023). However, producing composite beverages (or blends) using multiple plant ingredients is a promising yet underexplored way to boost both the sensory and nutritional value of plant-based beverages, especially in response to undesirable properties of single ingredient plant-based beverages. The motivation for blending different plant-based ingredients stems from both nutritional and sensory dimensions (Lee et al., 2024). For instance, certain nutrients found in one crop may complement those inherently present in another, leading to a more complete nutritional profile, which in turn, can compete against beverages derived from a single source (McClements & Grossmann, 2021). Beyond these nutritional benefits, blended formulations of beverages enhance taste complexity and can boost overall sensory appeal (Cardello et al., 2022; Rincon et al., 2020). However, achieving an optimal presentation of composite plant-based beverages blends whether in terms of nutritional, sensory, or even economic aspects remains a key challenge, notwithstanding the numerous possibilities of sourcing ingredient blends.

To this end, in developing plant-based beverage blends that can potentially offer satisfactory nutritional and sensory outcomes, the present study looks to the case of underutilized crops. Essentially, there exists a wide range of crops that are constrained in smaller markets yet

possess inherent nutritional components that are desirable for consumption (Jenkins et al., 2023; Knorr & Augustin, 2024). Furthermore, with the apparent desirable protein qualities of certain crops such as legumes and pseudocereals, they may be effective in fortifying existing mainstream products, allowing for further innovation and diversification. As a matter of fact, prior studies have explored potential food matrices that can be prepared using underutilized crops, such as bakery items and snacks, to underscore any resulting quality improvements (Kaur et al., 2025; Wang & Jian, 2022). Together with other studies on plant-based beverages, there still seems to be a focus on singular applications of these crops, emphasising individual ingredient differences (Duarte et al., 2022; Jaeger et al., 2024; Vaikma et al., 2021).

Aside from this, little is still known about consumers' emotional responses towards multiple plant-based beverage blends, especially for blends made with underutilized crops (Alemayehu et al., 2022). Previous studies have documented the nature of cognitive associations with these plant-based alternative beverages, where evocations related to adventure and sophistication were linked to a handful of ingredients mainly used in plant-based beverages (Cardello et al., 2022). Similar emotional responses between plant-based and animal-based dairy products have also been found elsewhere, with some plant ingredients receiving negative valence responses (Jaeger et al., 2023; McCarthy et al., 2017). However, some of these studies often concentrated on a sample of already existing and widely commercialized beverages, whereas not so much has been documented yet for the case of blends, especially blends made with underutilized crops. In this regard, understanding emotional responses to plant-based beverage blends can complement previous findings.

Therefore, the aim of the study is to examine consumer responses to the sensory and emotional aspects of plant-based beverages fortified with underutilized crops across different countries. This study also aims to further explore whether informing consumers about the underutilized status of these crops influences their quality perceptions and emotional reactions to the beverage blends. By addressing these aspects, the study highlights the potential of underutilized crop blends to enhance the positioning and appreciation of plant-based beverages.

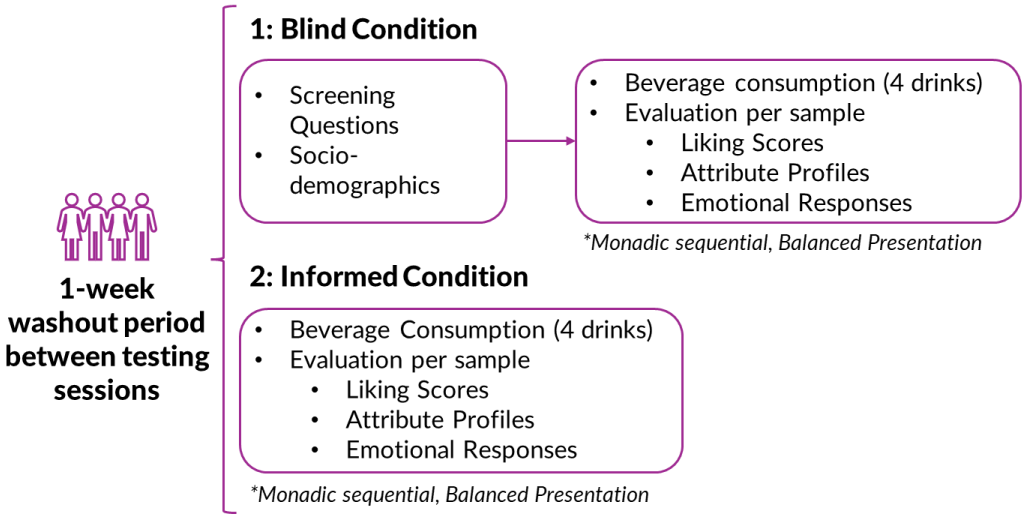
2. MATERIALS AND METHODS

2.1. Study Design and Beverages

This study was executed in four different countries: Belgium, Italy, Spain, and Serbia. Prior to beginning the study, ethical approval was obtained from the Research Ethics Committee of the Faculty of Political and Social Sciences at Ghent University (Ref. 2024-44). Informed consent was also obtained from all the participants in the experimental sessions.

In running the experimental sessions, a within-subjects design was employed where participants were made to evaluate multiple plant-based beverages both in blind and informed conditions. In the blind condition, no specific information about the content of the beverages was provided, whereas in the informed condition, the participants were made aware of the specific composition of the beverages they had to evaluate. A one-week washout period was placed in between the blind and informed condition sessions. Figure 1 presents a summary of the experimental design for this experiment.

Figure 1. Within-subjects design for the evaluation of the plant-based beverages



Four plant-based beverages were provided to the participants which they all evaluated across the different sessions (see Table 1). More specifically, the four plant-based beverages were made with a combination of different crops (oats, faba beans, lupines, and buckwheat) and a bulking agent (maltodextrin). Aside from the underutilized nature of these crops compared to mainstream products, these crops were selected due to their overall protein content, protein quality and acceptable sensory profiles from pilot testing procedures done in the laboratory (CROPDIVA, 2025). All beverages were first developed as soluble powders in the Institute of Agri-food Research and Technology (IRTA, Spain) and securely distributed to the partner countries for testing. To create the soluble powders, pulse spray drying procedures were applied (PCD-70, Ekonek, Spain) to the prepared liquid beverage formulations. The powders were spray dried with an outlet temperature range of 82-86^{0}C, a maximum feed flow rate of 71 L/h, and a total water evaporation rate of 28 kg/kg. Afterwards, the powders were stored at a refrigerator (Max. 15^{0}C) for a maximum of one month at for the duration of the experiment.

Table 1. Summary of the composition of the plant-based beverages

Abbrev.	Crop Blends	Formulation	Relative Protein Content
O	Oat	76% Oat flour 24% Maltodextrin	100% Oat protein w/w
OF	Oat and Faba Bean	71% Oat flour 22% Maltodextrin 7% Faba protein isolate	53% Oat protein w/w 47% Faba protein w/w
OFB	Oat, Faba, and Buckwheat	41% Oat flour 31% Buckwheat flour 22% Maltodextrin 6% Faba protein isolate	49% Faba protein w/w 29% Oat protein w/w 22% Buckwheat protein w/w
OFB	Oat and Lupin	40% Oat flour 36% Lupin flour 24% Maltodextrin	21% Oat protein w/w 79% Lupin protein w/w

A common protocol was utilized across the different study countries to handle the beverage powders. Each powder type was reconstituted into beverage form by adding water, with a 1:1.05 ratio by weight of distilled water and powdered beverage respectively. In reconstituting the beverages, both powder and water were combined in a container at the same time, and a

handheld whisk mixer was used to combine the ingredients until homogeneous. The reconstituted beverages were prepared and stored for at most, 48 hours at a maximum temperature of 15^0C. Prior to testing with the study participants, the reconstituted beverages were equilibrated to ambient temperature (20 °C) and manually agitated. Due to their physicochemical composition, phase separation of insoluble solids occurred during storage.

2.2. Participants

Participants were recruited through snowball techniques and consumer panels across the different countries following some inclusion and exclusion criteria. Only participants who were at least 18 years of age were allowed to join, and the participants had to be involved mainly or partially in their own household's food purchasing activities. Additionally, participants who had known general allergies to food products, eating or smelling disorders, were pregnant or lactating at the time of the experiment, and/or not open to try new plant-based drinks, were screened out of the study. In total, n = 371 participants were able to fully accomplish the two sessions of the experiment (tasting in blind and informed conditions). The participants received compensation (in accordance with prevailing financial rules per study country) upon successfully completing the study. Table 2 presents an overview of the respondents in this study, as aggregated at a country level.

Table 2. Country-level distribution of participants and socio-demographic profiles

Variable	**Total (n = 371)**	**Belgium (n = 105)**	**Italy (n = 95)**	**Spain (n = 103)**	**Serbia (n = 68)**
Age (Mean, SD)	37.0 (13.9)	26.3 (6.0)	43.5 (14.6)	40.8 (14.5)	38.8 (10.8)
Sex, n (%)					
Male	151 (40.7)	38 (36.2)	47 (49.5)	51 (49.5)	15 (22.1)
Female	220 (59.3)	67 (63.8)	48 (50.5)	52 (50.5)	53 (77.9)

2.3. Experimental Procedure

On the day of the experiment, participants were asked to come to the testing facilities to answer questionnaires administered through the EyeQuestion platforms. (Logic8 B.V., The Netherlands). The questionnaires began with the consent and screening questions, and after which, the participants were made to evaluate the different beverages. The beverages were served monadically, with the order balanced across participants, following a Latin square design. Furthermore, the beverages were served in transparent cups of approximately 20 mL per serving. Prior to and in between tasting each beverage, the participants were instructed to rinse their mouth with water.

For each beverage, the participants were made to provide their overall liking of the product, as measured by a linear 9-point hedonic scale (1: Extremely disliked – 9: Extremely liked). The participants were then instructed to perform a rapid sensory profiling of the different beverages through the CATA (Check-All-That-Apply) approach, where the participants evaluated different sensory modalities of each (appearance, odour, taste/flavour, and texture). In total, 19 terms were generated for the CATA procedure (five for appearance, three for odour, seven for taste/flavour, and four for texture, see Table 5). These terms were derived from existing literature and also based on pilot testing done by the researchers which scoped terms to retain for the evaluations (Appiani et al., 2023; Jaeger et al., 2023, 2024). In the pilot-testing sessions, the researchers evaluated all the beverages and generated possible attribute descriptors. Following an iterative round of testing, additional attributes were obtained based on total frequency citation.

Concerning the emotional profiling of the beverages, an emoji questionnaire based from the EsSense profile was used, again following a CATA format (Jaeger et al., 2017). Instead of word-based emotional profiling questionnaires, the use of emojis was motivated by their ability

to discriminate between beverages while minimizing translation issues, thereby allowing for a broader understanding of emotional reactions that account for potential cultural differences in language. Aside from the questions on the beverage evaluations, socio-demographic data were also obtained, particularly concerning the age and sex of the respondents.

This experimental procedure was replicated for the informed condition, with the modifications done on the presentation of the beverages. In addition, all questionnaires were first produced in English and were subsequently translated by native speakers to the native languages of the target study population.

2.4. Data Analysis

All data were collected and compiled by June 2025. After obtaining the complete dataset, the responses were aggregated across all countries. First, the hedonic liking scores were examined, particularly through difference tests. Here, comparisons were made among all the beverages to identify those which were relatively comparable to the single crop formulation (oat only), in terms of the liking scores generated by the consumers. Aside from the intra-sample differences with the four beverages provided, variations between the two testing sessions (informed and blind conditions), age, and gender effects were also accounted for. To this end, a repeated-measures ANOVA procedure was conducted to test these differences and the model was specified with testing conditions (blind/informed) defined as the within-subjects factors and age, country, and gender were the between-subjects factors, following similar approaches in prior literature (Pereira et al., 2019; Schouteten et al., 2017; Spinelli et al., 2015). Prior to this, normality of the data was assessed through Shapiro-Wilk's tests, histograms, and Q-Q plots. Furthermore, homogeneity of variance was checked through Levene's test. For any significant group differences found through the ANOVA procedure, estimated marginal means were computed, along with Bonferroni corrections.

Regarding the CATA data for the different sensory modalities of the beverages, Cochran's Q and McNemar tests were first executed to determine which descriptors discriminated the different beverages the most. Afterwards, correspondence analyses were conducted to map significant associations between the beverage (blend type) and sensory characteristics (appearance, odour, taste/flavour, texture). Together with mapping the beverages and the descriptors, country factors were also considered, and this allowed an examination of country-level differences in perceived beverage properties. Finally, the emotional profiling responses from the emoji questionnaire were treated as CATA data, and hence, correspondence maps were also generated, alongside hypothesis testing through the Cochran's Q and McNemar procedures (Meyners et al., 2013).

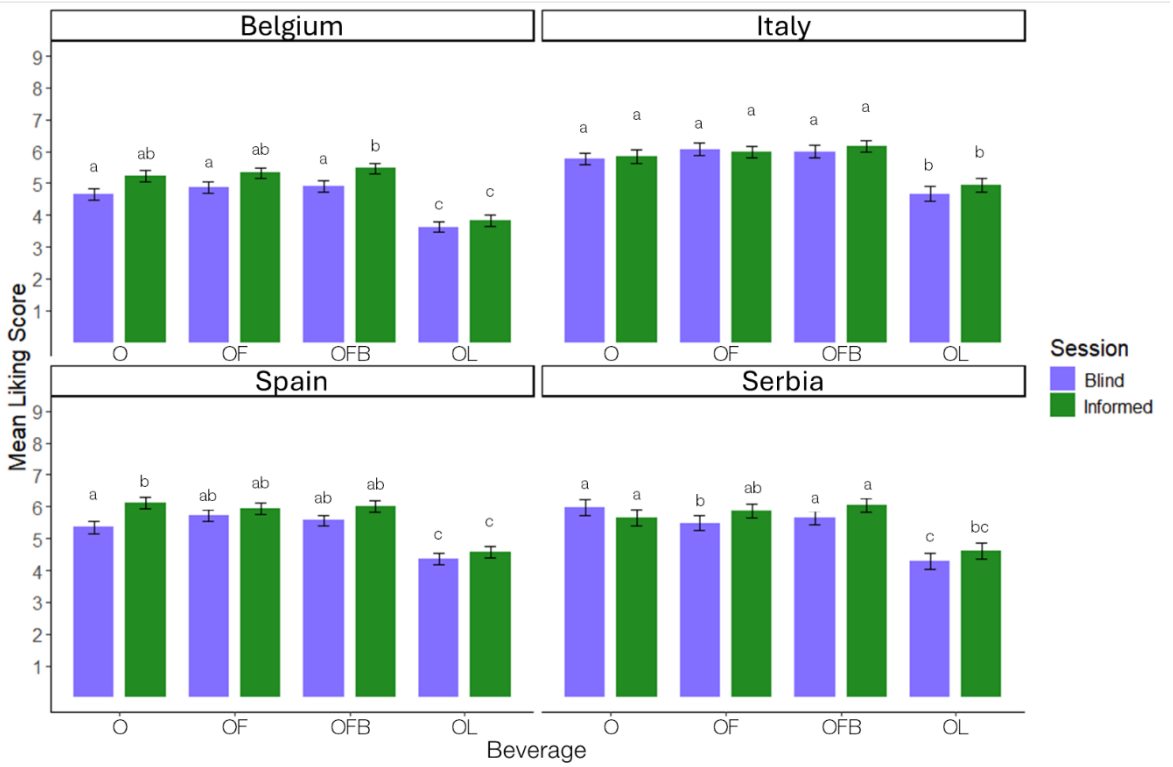
The alpha level was set at 5% for all hypothesis tests conducted in the study. Data were analysed through R via EyeOpenR (Version 6.1.2.5).

3. RESULTS

3.1. Overall liking scores under blind and informed conditions

The liking scores (1: Extremely dislike – 9: Extremely like) for the beverages (oat, oat-faba, oat-faba-buckwheat, oat-lupine) in the blind and informed testing conditions across countries (Belgium, Italy, Spain, Serbia) are shown in Figure 2. After evaluating the responses gathered from all the study participants, most of the plant-based beverages obtained slightly favourable liking scores, and no extreme reactions (both positively and negatively) were recorded on average (Range: 4-7), although significant differences were verified through the ANOVA procedure after considering country, condition, age, and gender factors (Table 3).

Figure 2. Comparison of hedonic liking scores for the beverage, mapped between blind and informed testing conditions across countries



Note. O: Oat only, OF: Oat and Faba beverage, OFB: Oat, Faba, and Buckwheat beverage, and OL: Oat and Lupin beverage. Different letters indicate significant differences according to the ANOVA procedure.

Additionally, in Table 3, when examining the interaction effects among these factors, a significant interaction was found among beverage, testing condition and age factors, indicating that differences are conditional ($F_{Huynh\text{-}Feldt}$ = 3.7, df = 6.4, p < 0.001). Notably, the effect of condition on beverage liking was significant ($F_{Huynh\text{-}Feldt}$ = 15.8, df = 6.4, p < 0.001), confirming the role of the information provision on the beverage liking scores, but these influences must be contextualized with age. Pearson correlations revealed significant positive relationships with age and the beverages (except the oat beverage in blind conditions). No significant effects were found when factoring in gender and country for the liking scores in this respondent pool. Taken together, these results highlight both the broad and nuanced ways in which beverage formulation and informational framing can interact to shape consumer preferences.

Table 3. Effects of beverage, condition, age, gender, and country on beverage liking scores

Effect	df	$F_{Huynh\text{-}Feldt}$	p-value
Beverage:Condition	6.4	15.8	< 0.001*
Beverage:Condition:Age	6.4	3.7	< 0.001*
Beverage:Condition:Gender	6.4	1.7	0.12
Beverage:Condition:Country	19.3	1.3	0.17
Beverage:Conditoin:Gender:Country	19.3	0.9	0.65

Note. * Indicates significance at the 0.05 level.

At an overall level, the liking scores of the beverages containing oat and faba (M = 5.78 ± 1.79), and oat, faba, and buckwheat (M = 5.73 ± 1.78) were generally comparable to the single ingredient beverage (oat only, M = 5.53 ± 1.85) in terms of how the participants appreciated these beverages. Through an initial inspection, only the beverages made with the oat and lupine beverage received consistently the lowest liking scores on average (M = 4.69 ± 2.06), and in some instances, these beverages were generally negatively appreciated by the

respondents. When it comes to country-level differences, respondents from Belgium tended to give lower liking scores across the board, for all plant-based beverages. Respondents from Italy, Serbia, and Spain on the other hand, seemed to provide a higher range of liking scores for the beverages (See Appendix 1 for values).

Table 4 displays the estimated marginal mean liking scores for each of the beverages tested, comparing both blind and informed testing conditions. The oat and lupine beverage consistently obtained the lowest liking score, and the difference with the other beverages was significant both in the blind and informed conditions ($F_{Pillai\ (7,356)} = 32.2$, $p < 0.001$). However, while it was observed that the oat, faba, and buckwheat beverage had the highest absolute rating, the respondents' liking for this beverage did not differ largely compared to the oat only beverage, and even the oat and faba beverage.

Table 4. Comparison of mean liking scores for all beverages per test condition

Condition	**Blind Condition**		**Informed Condition**	
Beverage	**EM Mean**	**SE**	**EM Mean**	**SE**
Oat	5.5	0.1	5.7	0.1
Oat, Faba	5.5	0.1	5.7	0.1
Oat, Faba, Buckwheat	5.5	0.1	5.9	0.1
Oat, Lupine	4.2	0.1	4.5	0.1

Note. EM Mean: Estimated marginal mean, SE: Standard error

3.2. Attribute profiling of plant-based beverages

Cochran's Q test identified a variety of descriptors which were able to discriminate among the four different beverages (Table 5). In the blind testing condition, 89.5% of the descriptors were able to discriminate the beverages, whereas the taste descriptor "sour" and the texture descriptor "silky" did not elicit significant differences. In the informed condition, only the texture descriptor "silky" was not discriminating, and 94.7% of the attributes were able to discriminate.

Table 5. Cochran's Q tests for beverage attributes in blind and informed testing conditions

Blind Testing Conditions				**Informed Testing Conditions**			
Descriptor	**Q**	**df**	**p-value**	**Descriptor**	**Q**	**df**	**p-value**
Appearance				*Appearance*			
Brown	**386.29**	**3**	**<0.001**	**Brown**	**427.82**	**3**	**<0.001**
Light	**205.41**	**3**	**<0.001**	**Light**	**200.73**	**3**	**<0.001**
Opaque	**17.03**	**3**	**<0.001**	**Opaque**	**19.57**	**3**	**<0.001**
Translucent	**63.17**	**3**	**<0.001**	**Translucent**	**63.84**	**3**	**<0.001**
Yellow	**350.78**	**3**	**<0.001**	**Yellow**	**432.03**	**3**	**<0.001**
Odor				*Odor*			
Cereal	**20.28**	**3**	**<0.001**	**Cereals**	**24.98**	**3**	**<0.001**
Mild	**50.21**	**3**	**<0.001**	**Mild**	**28.17**	**3**	**<0.001**
Vegetal	**32.78**	**3**	**<0.001**	**Vegetal**	**47.62**	**3**	**<0.001**
Taste / Flavour				*Taste / Flavour*			
Bitter	**101.26**	**3**	**<0.001**	**Bitter**	**122.12**	**3**	**<0.001**
Sour	2.26	3	0.52	**Sour**	**22.2**	**3**	**<0.001**
Sweet	**53.71**	**3**	**<0.001**	**Sweet**	**63.66**	**3**	**<0.001**
Legume	**26.91**	**3**	**<0.001**	**Legumes**	**73.01**	**3**	**<0.001**
Nutty	**42.78**	**3**	**<0.001**	**Nutty**	**59.74**	**3**	**<0.001**
Oat	**9.31**	**3**	**0.025**	**Oat**	**25.08**	**3**	**<0.001**
Vegetal (Taste)	**8.66**	**3**	**0.034**	**Vegetal (Taste)**	**9.54**	**3**	**0.023**
Texture				*Texture*			

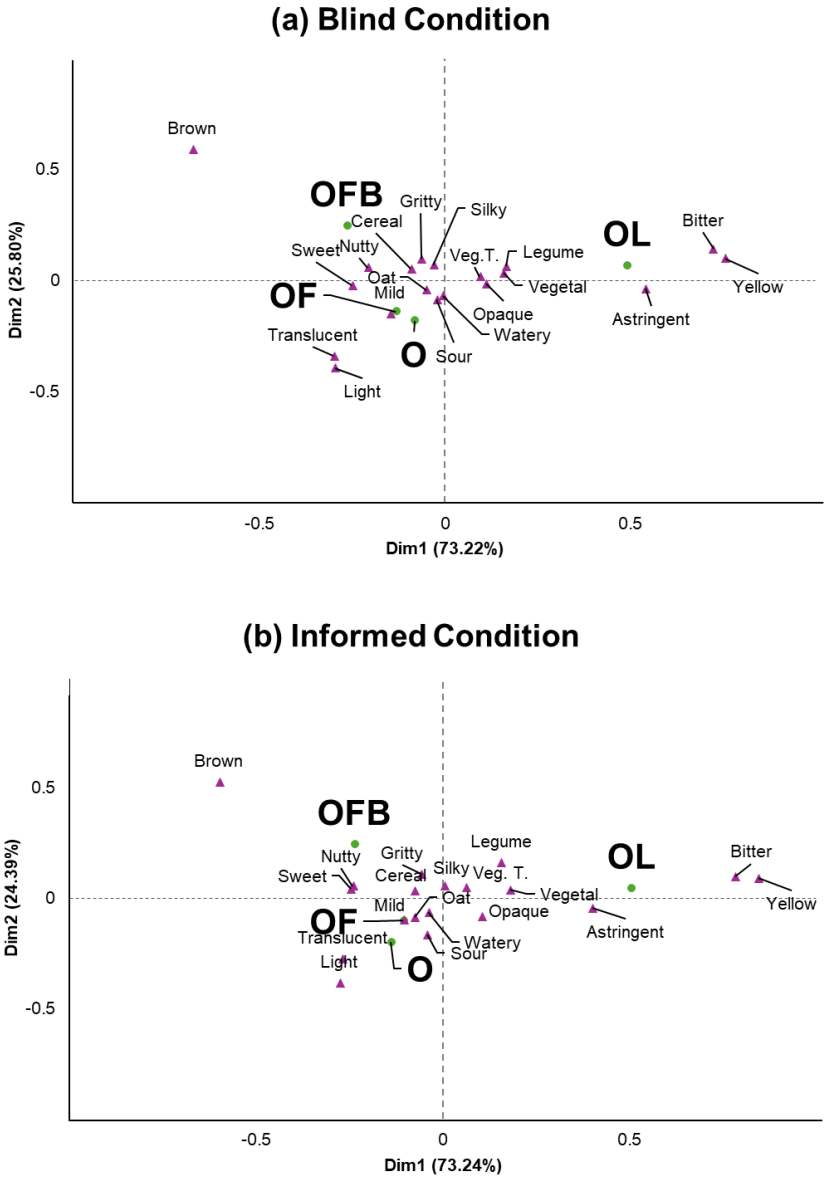
Astringent	**58.8**	**3**	**<0.001**	**Astringent**	**35.71**	**3**	**<0.001**
Gritty	**18.78**	**3**	**<0.001**	**Gritty**	**29.36**	**3**	**<0.001**
Silky	4.85	3	0.183	Silky	4.5	3	0.213
Watery	**14.03**	**3**	**0.003**	**Watery**	**19.02**	**3**	**<0.001**

Note. Significant discriminators marked in bold.

Extending the profiling procedure, results from the McNemar test also yielded some product level insights (See Appendix 2 for full results). For example, when characterizing the appearance of the beverages, the faba, oat, and buckwheat beverage was consistently described as a “brown” beverage in comparison to the others, both in blind and informed conditions ($p < 0.05$). A similar observation was made for the oat and lupine beverage, where this beverage was particularly marked as “yellow” ($p < 0.05$). For the other characteristics, the McNemar test also revealed that the oat only beverage was somewhat like the oat and faba and oat, faba, and buckwheat beverages in various modalities (appearance, aroma, taste/flavour, texture). These three beverages were described similarly as having a “vegetal” aroma, a “sweet” taste, and an “oat” flavour, among others ($p > 0.05$). However, during the informed testing condition, these similarities were not preserved, indicating potentially an information effect, especially as the participants were made aware of what the beverages contained. Even during the informed testing condition, not all beverages were consistently described as having an “oat” flavour, despite that all beverages contained oat as a base ingredient.

To summarize, Figure 3 shows the biplots from the correspondence analysis procedure, and this presents strong associations across the beverages with the descriptors used. From Figure 3, several associations can be identified. Oat and oat-faba blends were somehow “translucent” and “light”, whereas the oat, faba, and buckwheat blend was “nutty” and “gritty”. It is also confirmed that the oat and lupine beverage was consistently viewed as “bitter’, “yellow”, and “astringent”, and these were descriptors which could have been linked to the significantly lower liking scores for this particular beverage. Both biplots for the blind and informed testing conditions are presented due to differences in attribute elicitation.

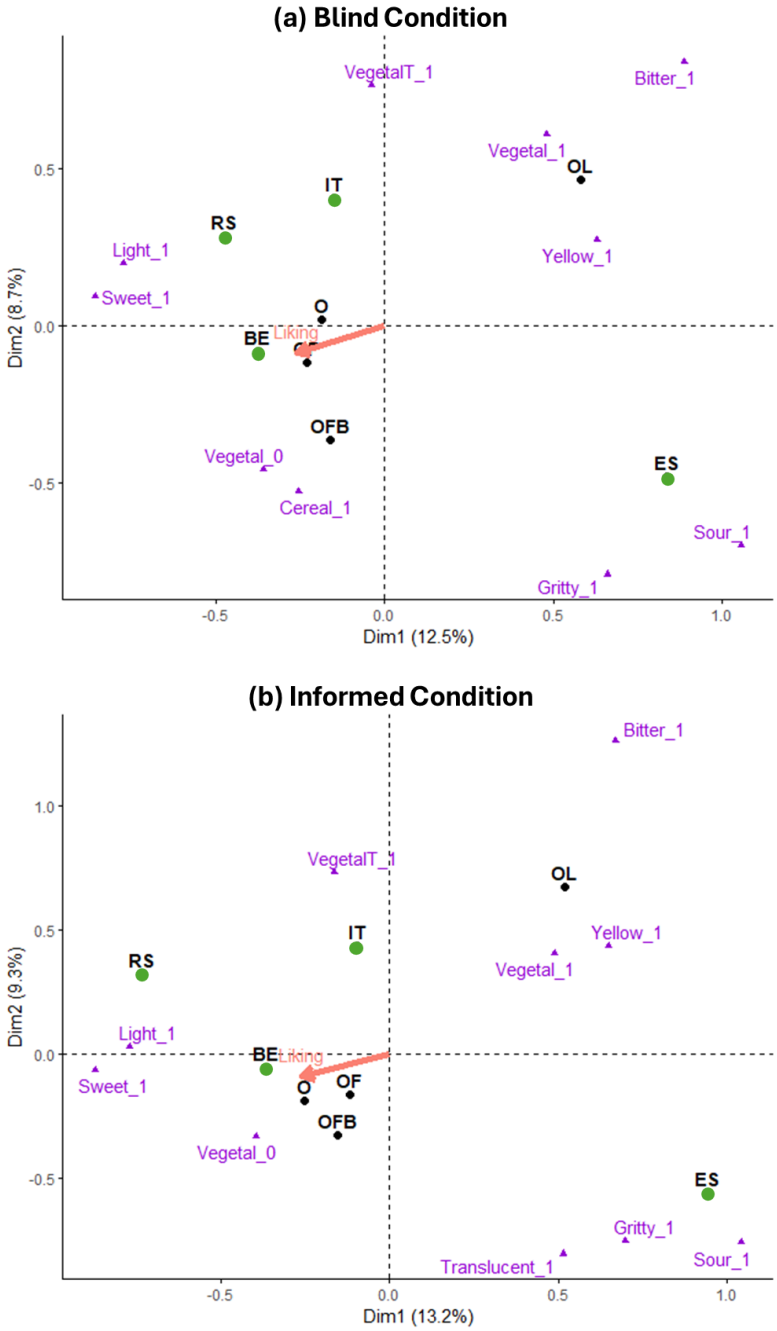
Figure 3. Correspondence analysis maps for beverage attribute descriptors in (a) blind and (b) informed conditions



Note. O: Oat only, OF: Oat and Faba beverage, OFB: Oat, Faba, and Buckwheat beverage, and OL: Oat and Lupine beverage.

Finally, country-level differences were factored in, and Figure 4 displays a biplot summarizing these associations.

Figure 4. Country-level differences in perceived beverage attributes, grouped into (a) blind and (b) informed conditions



Note. O: Oat only, OF: Oat and Faba beverage, OFB: Oat, Faba, and Buckwheat beverage, and OL: Oat and Lupine beverage. IT: Italy, ES: Spain, BE: Belgium, RS: Serbia. Pink arrows indicate the mapped liking scores of the respondents. Only the 10 main contributing attributes were included for improved readability.

From Figure 4, there were some country-specific tendencies observed in the CATA task. For instance, participants from Spain were more likely to detect the texture attribute “gritty” and the taste attribute “sour” for certain beverages. This was consistent when comparing both blind and informed testing conditions. On the other hand, no strong associations between the selection of descriptors could be seen when investigating responses from Belgium, Italy, and Serbia, indicating a degree of homogeneity in their evaluations for the beverages. Afterwards, observing the decomposition of the liking scores on the correspondence map, beverage liking

seemed to be opposed to the presence of the attributes “bitter”, “vegetal”, and “yellow”, and these attributes were marked in the oat and lupine beverage, as discussed previously. Conversely, liking was linked towards beverages that were light and sweet. This was also consistent in both blind and informed testing conditions.

3.3. Emotional associations towards plant-based beverages

Table 6 presents the outcomes of Cochran’s Q test for the CATA task on emoji. There were fewer significant discriminators observed when it comes to the emotional associations with the different beverages (Blind: 56%, Informed: 88%). For instance, in both the blind and informed testing conditions, the emoji 👏 (clapping hand sign), 👎 (thumbs down), and 😜 (face with stuck out tongue) were some of the few emoji which could discriminate the beverages. While not a lot of these emoji did so, the significant discriminators had various meanings, covering a wide array of valences in expressing emotional associations. From the previous example, the emoji 👏 (clapping hand sign), 👎 (thumbs down), and 😜 (face with stuck out tongue) represent various feelings such as appreciation, disapproval, and cheekiness respectively.

Table 6. Cochran’s Q tests for emoji descriptors in blind and informed testing conditions

Blind Testing Conditions				**Informed Testing Conditions**			
Descriptor	**Q**	**df**	**p-value**	**Descriptor**	**Q**	**df**	**p-value**
👏	**8.49**	**3**	**0.037**	👏	**13.69**	**3**	**0.003**
😖	**18.07**	**3**	**<0.001**	😖	**22.14**	**3**	**<0.001**
😳	**8.88**	**3**	**0.031**	😳	**11.56**	**3**	**0.009**
😒	**21.95**	**3**	**<0.001**	😒	2.59	3	0.459
😎	3.22	3	0.359	😎	**13.46**	**3**	**0.004**
😞	3.94	3	0.268	😞	**24.06**	**3**	**<0.001**
😑	2.5	3	0.474	😑	**13.22**	**3**	**0.004**
💀	5.34	3	0.148	💀	6.39	3	0.094
😰	3.55	3	0.315	😰	**9.38**	**3**	**0.025**
👎	**60.67**	**3**	**<0.001**	👎	**50**	**3**	**<0.001**
👍	**39.99**	**3**	**<0.001**	👍	**40.58**	**3**	**<0.001**
😝	2.47	3	0.482	😝	1.24	3	0.742
😜	**13.03**	**3**	**0.005**	😜	**11.33**	**3**	**0.01**
🤪	7.11	3	0.068	🤪	**12.57**	**3**	**0.006**
😵	**9.45**	**3**	**0.024**	😵	**9.29**	**3**	**0.026**
😵	3.98	3	0.263	😵	**7.97**	**3**	**0.047**
😳	1.63	3	0.654	😳	**15.06**	**3**	**0.002**
👌	**23.34**	**3**	**<0.001**	👌	**26.69**	**3**	**<0.001**
😔	1.17	3	0.76	😔	**9.54**	**3**	**0.023**
😩	7.81	3	0.05	😩	**20.12**	**3**	**<0.001**
😫	**68.2**	**3**	**<0.001**	😫	**47.5**	**3**	**<0.001**
😎	**8.35**	**3**	**0.039**	😎	**19.92**	**3**	**<0.001**
😊	**23.48**	**3**	**<0.001**	😊	**45.81**	**3**	**<0.001**
😄	**11.8**	**3**	**0.008**	😄	**17.04**	**3**	**<0.001**
😉	7.82	3	0.05	😉	**19.63**	**3**	**<0.001**

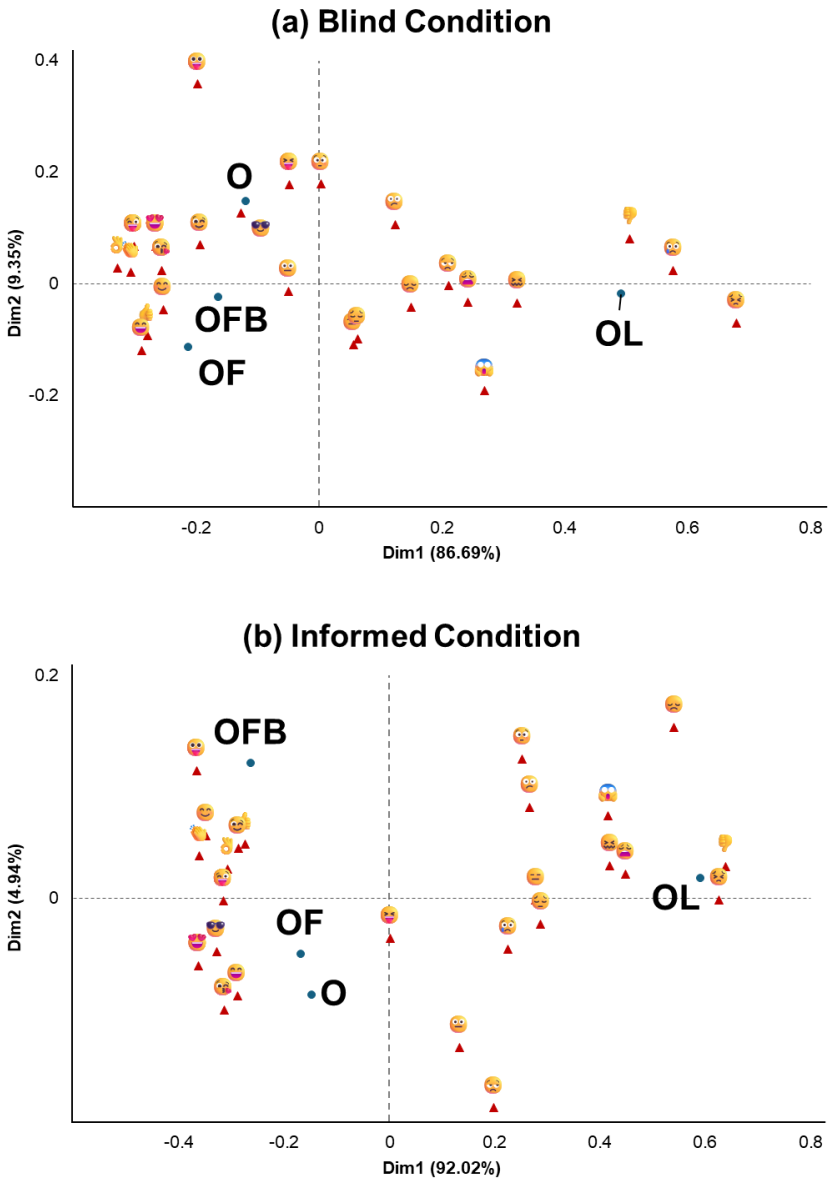
Note. Significant discriminators marked in bold.

From the McNemar procedure, similar to the findings revealed from analysing the attribute descriptors, some emoji were seen to be associated strongly with certain beverages (See Appendix 3 for full results). For example, the emoji 👏 (clapping hand sign) was significantly associated with three beverages (oat, oat and faba, oat, faba and buckwheat) and this was

differently elicited for the oat and lupine beverage. This was seen as well with the 👌 (OK hand sign), 😉 (winking face), 🤪 (face with stuck out tongue), 😊 (smiling face) emoji, where the liked beverages were rated as such. Conversely, the more negative valence emoji were distinctively linked to the oat and lupine beverage, such as the emoji 😖 (confounded face) and 😣 (persevering face).

Putting these findings together, Figure 5 presents the correspondence biplot covering the emoji and beverage associations. As seen in Figure 5, there seems to be a substantial split between the positive valence and negative valence emoji. Moreover, in the informed testing condition, these negative valence emoji associations with the oat and lupine beverage displayed a stronger degree, indicating that knowledge of the blend composition may have drawn certain expectations among the consumers.

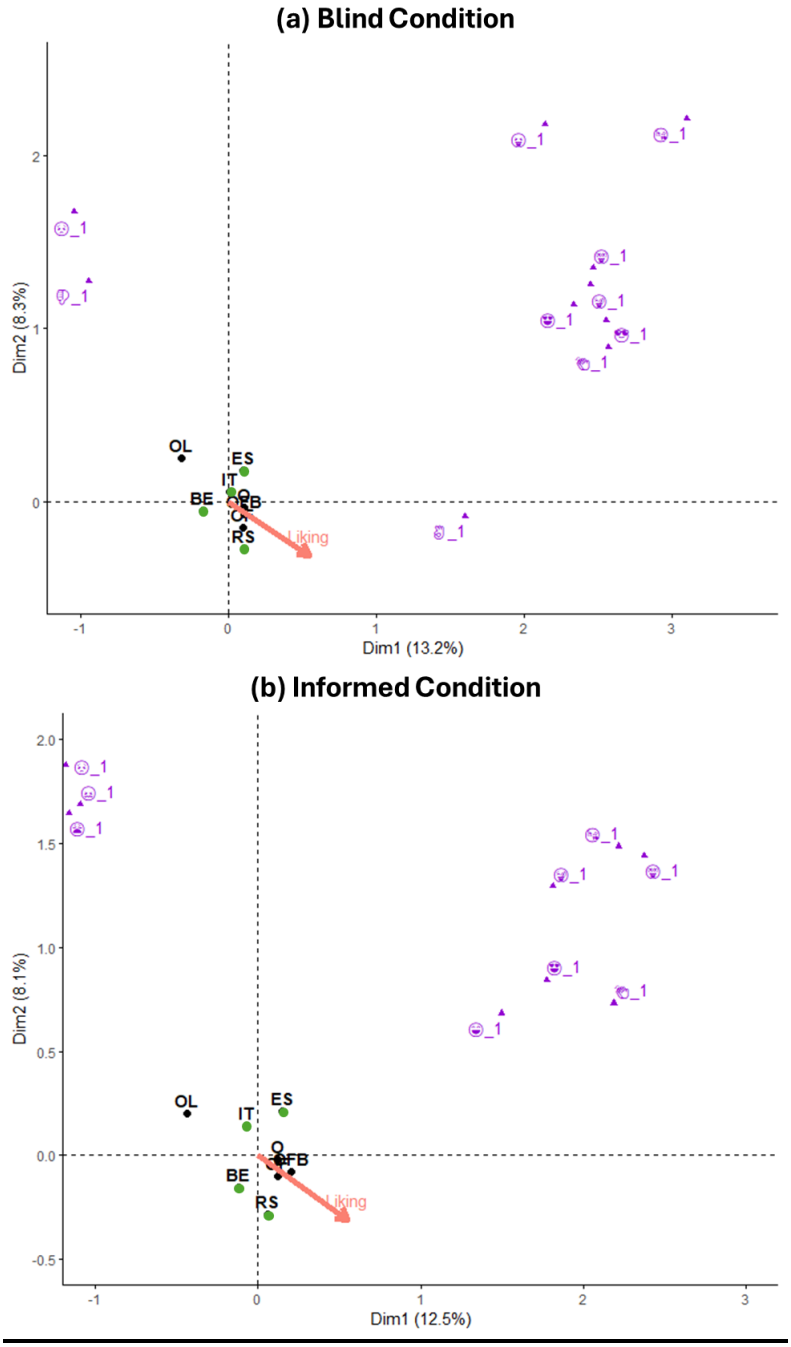
Figure 5. Correspondence analysis maps for emoji-beverage associations in (a) blind and (b) informed conditions



Note. O: Oat only, OF: Oat and Faba beverage, OFB: Oat, Faba, and Buckwheat beverage, and OL: Oat and Lupine beverage.

In considering any country-level effects in eliciting emoji associations, no strong country-level associations were found, even after comparing both blind and informed testing conditions (Figure 6a-b). No particular country seemed to favour selecting particular emoji (or indirectly, emotional expressions) in describing how the consumption of the beverages evoked feelings. In addition, the liking scores of the respondents were somehow more linked to emoji of positive valence (e.g. 👌, OK hand sign), as expected, and conversely, those with negative valence were opposite from the liking associations (e.g. 👎).

Figure 6. Correspondence analysis maps for country-level differences in emoji associations, grouped into (a) blind and (b) informed conditions



Note. O: Oat only, OF: Oat and Faba beverage, OFB: Oat, Faba, and Buckwheat beverage, and OL: Oat and Lupine beverage. IT: Italy, ES: Spain, BE: Belgium, RS: Serbia. Pink arrows

indicate the mapped liking scores of the respondents. Only up to the 10 main contributing emojis were included for improved readability.

4. DISCUSSION

The first objective of this study was to understand the potential of plant-based beverage blends among consumers, specifically looking at sensory properties that might drive acceptance. In this regard, this study tested blends of oat beverages fortified with proteins sourced from a variety of underutilized crops. In food processing, blends of ingredients are often done for various reasons, including taste improvement, nutrient content development, and other economic reasons (Chakraborty et al., 2022; Martins et al., 2022). With the present study, it was demonstrated that blending plant-based ingredients may have potential in eliciting similar (but not entirely more competitive) reactions among consumers compared to beverages with a single main ingredient. This has then implications on the way products are formulated in the market. On one hand, diversifying ingredient bases and product offerings may be a key strategy to capture or retain current markets and to maximize sustainability in food production (Malekpour et al., 2024; Raak et al., 2022). On the other hand, blending more familiar plant-based ingredients with emerging crops (such as underutilized crops) may be strategic in increasing their visibility (Bhardwaj & Pandey, 2011). These underexploited crops often struggle with visibility despite the numerous potential benefits they can accord to the food value chain (Kaur et al., 2025). Hence, blending has been demonstrated as a potential workaround for such types of crops.

From the different beverage blends presented in this study, two beverages emerged to be preferrable, namely the beverages prepared from oat and faba, and oat, faba, and buckwheat. When comparing these beverages to the oat-only formulation, no significant differences at least in liking scores were obtained, signalling the potential of these beverages to compete with single ingredient formulations. Several characteristics were also identified which were linked to these most liked beverages. For product development purposes, those associated with higher liking scores include attributes such as having a light texture or a sweet taste. These attributes can be seen as typical of the product class (e.g. dairy, plant-based alternative beverages) and can thus be leveraged further (Appiani et al., 2023; Jaeger et al., 2024; Moss et al., 2023; Waehrens et al., 2023), especially when dealing with blends so that no single flavour from the ingredients is overpowering. Furthermore, some attributes such as a bitter taste, yellow colour, and vegetal aroma were associated with the oat and lupine beverage, which was least liked. This is somewhat expected since these attributes deviate from preferential aspects of conventional beverages. Needless to say, differences in consumer profiles have to be taken into account when determining product acceptance, especially since different groups tend to associate specific factors such as health, sustainability, and value with plant-based beverages (Runte et al., 2024). While this study showed that the respondents' countries did not lead to major differences in affecting the acceptance of the beverages, it is important to note common preferences for specific blend formulations so that they may appeal to broader audiences.

The next objective of this study was to evaluate whether presenting underutilized crops as the blended ingredients in fortifying the plant-based beverages would affect consumer acceptance. In sum, providing consumers with information as to the blended composition of the crops seems to have increased liking scores for the beverages, but this is also dependent on the age of the participant. Identifying the ingredients as coming from underutilized crops (described in the informed condition as crops *"...that are not popular in mainstream markets and are also called neglected species…"*) may have positively influenced how respondents appreciated the beverages. This seemingly goes against prior evidence, where designating products as only made of unconventional plants led to less favourable ratings (Barbosa et al., 2021; Santos et al., 2025). While this was observed, the underutilized crops in the study were blended with a more familiar and mainstream crop (oat), and this could have led to better

expectations from the participants, as also hypothesized by Santos et al. (2025). Nevertheless, as with other messaging used to promote food products, a careful balance must be identified. Otherwise, consumers might eventually become too saturated with information, lessening their ability to discern and maximize the information presented in the products (Bawden & Robinson, 2020; Maksi et al., 2024).

Afterwards, this study also aimed to scope what emotional responses can be associated with the fortified plant-based beverages, as evidenced by the variations of associations from the emoji CATA task. To this end, understanding emotional responses towards plant-based beverages made with underutilized crops requires some more clarification. For many consumers, initial impressions matter, and having early positive reactions towards a certain product may facilitate acceptance in the long run (Delarue & Blumenthal, 2015; Mehta et al., 2024). In this sense, determining what emotional responses are triggered at the first instance is crucial to secure awareness. However, for a product such as beverages, it is important to observe whether emotional responses to the same product can be stable in the long run, or whether consumers provide fleeting responses (following the notions of the mere-measurement effect) (Ahlich et al., 2023; Morwitz & Fitzsimons, 2004). As with the case of other low involvement products, acceptance may stagnate in the future, and this calls for more varied formulations of beverages (Calvo-Porral et al., 2018). Furthermore, with the numerous sources of plant-based crops which can be used for making beverages in retail at present, understanding emotional triggers for underutilized crops can help better position them among consumer markets.

In the present study, the generally least liked beverage (oat and lupine), was mostly associated with negative valence emoji, thereby indicating another dimension of consumer appreciation. This trend was observed in both testing conditions, and even knowing the composition did not significantly elicit higher liking scores. This could have occurred due to two main reasons. First, the sensory properties emerging from the use of lupines could have taken priority in the participants' evaluations, overriding any perceived benefits from the use of an underutilized crop such as lupine (Abreu et al., 2023; Schlegel et al., 2019). Secondly, due to the highly niche production and consumption context of lupine in Europe (and its status as a potential allergen), the respondents were unfamiliar with the crop and thus may have been less enthusiastic about its use. Evidently, the utilisation of lupine in Europe is relegated mostly to feed purposes and hence, consumers may not be aware of their food product application potentials (Lucas et al., 2015; Szczepański et al., 2022). Similar to other unfamiliar foods, the degree of uncertainty towards a particular product (in this case, lupine) may have led to more negative perceptions (Tuorila & Hartmann, 2020).

Interestingly, for the beverages which were more or less appreciated (oat, faba, buckwheat), there were some nuanced emoji used to describe them, besides the expected positive valence emoji. For instance, the results showed that emoji such as 😜 (winking face), and 🤪 (face with stuck out tongue) were associated with the liked beverages in the study. These emoji are linked with connotations of humour or cheekiness, indicating a more specific perception of the plant-based beverages studied. Instead of generalizing the positive emoji associations found, it well may be that consumers attach certain cognitive sentiments to these beverages, especially under the context of novelty or surprise (Jaeger & Giacalone, 2021).

Given the findings of this study, there are still some aspects to consider regarding the methods employed. First, this study utilized a selection of crops to investigate the sensory potential of combining multiple ingredients in a single beverage formulation. While there are certainly other crops that can be used, this study leveraged the case of underutilized crops which have been shown to fortify beverages with proteins of superior quality, following confirmatory laboratory testing. The study likewise showed indications of using underutilized crops in formulating new beverages. Nevertheless, upcoming studies along this line can use designs of experiments to

identify other new blend formulations among various ingredient type permutations (Galvan et al., 2021; Hidalgo-Piamba et al., 2024).

Another factor which might have affected the sensory profiles of the beverages could have been any unaccounted physical food matrix interactions of the beverage ingredients. For example, combining buckwheat and faba could yield unique profiles. Additionally, during the processing of plant-based beverages, some undesirable compounds perceived upon consumption could arise (Pucci et al., 2024). Prior studies have likewise shown how different compounds in plant-based ingredients can lead to undesirable flavour compounds that can be perceived by consumers such as off, rancid, or grassy flavours (Xie et al., 2023). To minimize these types of ingredient interactions, all beverages used in this study shared oat as a common ingredient, allowing for baseline comparisons. Aside from these, the use of emoji to measure elicited emotional responses can be further explored. From this study, some emoji were not utilized, and this could have been either due to respondent biases or perhaps their interpretability. While complex, other methods to measure emotional responses may be employed, such as the use of other lexicons or devices that can measure implicit reactions linked to emotional responses (Kaneko et al., 2021; Schouteten, 2021). Nevertheless, the study revealed the practicality of using emoji to measure emotional associations with food products across different European regions.

5. CONCLUSION

This study demonstrates the potential of underutilized crops such as faba bean, buckwheat, and lupine when blended with oat in plant-based beverages, with some blends being able to comparatively compete with single-formulation oat beverages. More importantly, the study showed that consumer perceptions for beverage blends focus on their sensory properties as well as how underutilized crops are presented to consumers. As this study has showed, highlighting the nature of the ingredient blends, particularly their status as underutilized ingredients can enhance the overall acceptance of beverages. This further emphasizes the role of framing beverage blends to better position their unique product characteristics and composition. Furthermore, this study also reinforced the need to scope emotional responses alongside the sensory properties of beverage blends. In particular, this study forwards that evocations of positive feelings such as humour, novelty, and surprise were associated with preferred beverage blends. In this sense, capitalizing on the marketing of beverage blends through these aspects can perhaps make these beverages more salient and appealing for consumers who are willing to try them.

Beyond these conclusions, future studies can look at the potential of using underutilized crop blends in other food matrices, aside from just beverages alone. Moreover, while this study focused on acceptance and even emotional responses to plant-based beverage blends, other diverse acceptance measures can be examined, such as whether consumers would be willing to consume these beverages on a frequent basis. Sensory experiments following the same theme can explore other dimensions of product acceptance, and they can likewise consider the use of trained panellists for evaluation. Lastly, providing different message frames based on other distinguishing characteristics of underutilized crops can be tested to see what messaging strategies can resonate well with consumers.

ETHICAL STATEMENT

Ethical approval for the involvement of human subjects in this study was granted by the Research Ethics Committee of the Faculty of Social and Political Sciences, Ghent University (Reference number 2024-44, 12/11/2024).

DECLARATION OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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AUTHORS' CONTRIBUTIONS

S. B. worked on the conceptualization, methodology, formal analysis, writing – original draft, writing – review and editing. M. L., C. P., C. C., worked on the conceptualization, methodology, writing – review and editing, and supervision. L. G., C. B-O., A. C., T. D-H., M. Pe., D. Š, D. U., M. Po., worked on the conceptualization, methodology, writing – review and editing, supervision, and resources. H. D. S., J. J. S. worked on conceptualization, writing – review and editing, supervision, and project administration.

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APPENDICES (List)

Appendix 1. Mean liking scores for the beverages, as grouped by condition (blind/informed) and country

Belgium			**Italy**		
Oat	Mean	Std.Dev.	Oat	Mean	Std.Dev.
Blind	4.65	1.89	Blind	5.76	1.73
Informed	5.24	1.76	Informed	5.85	2.05
Oat/Faba	Mean	Std.Dev.	Oat/Faba	Mean	Std.Dev.
Blind	4.87	1.76	Blind	6.06	1.91
Informed	5.32	1.71	Informed	5.99	1.74
Oat/Faba/Buckwheat	Mean	Std.Dev.	Oat/Faba/Buckwheat	Mean	Std.Dev.
Blind	4.9	1.78	Blind	6	1.87
Informed	5.48	1.65	Informed	6.16	1.84
Oat/Lupin	Mean	Std.Dev.	Oat/Lupin	Mean	Std.Dev.
Blind	3.62	1.79	Blind	4.67	2.14
Informed	3.85	1.83	Informed	4.94	2.06
Spain			**Serbia**		
Oat	Mean	Std.Dev.	Oat	Mean	Std.Dev.
Blind	5.35	1.93	Blind	6.87	0.57
Informed	6.13	1.77	Informed	5.65	2.1
Oat/Faba	Mean	Std.Dev.	Oat/Faba	Mean	Std.Dev.
Blind	5.74	1.78	Blind	6.87	0.57
Informed	5.93	1.78	Informed	5.87	1.79
Oat/Faba/Buckwheat	Mean	Std.Dev.	Oat/Faba/Buckwheat	Mean	Std.Dev.
Blind	5.56	1.77	Blind	6.87	0.57
Informed	6.02	1.79	Informed	6.04	1.82
Oat/Lupin	Mean	Std.Dev.	Oat/Lupin	Mean	Std.Dev.
Blind	4.37	1.81	Blind	6.87	0.57
Informed	4.58	1.87	Informed	4.62	2.11

Appendix 2. McNemar Tests for comparing attributes elicited across all beverages

The following table presents the results of the McNemar tests for all attributes tested. Different sub-groups are denominated by capital letters. Values indicate the total number of times the particular attribute was selected for the corresponding beverage. Differences are grouped at 5% significance level.

BLIND CONDITION					**INFORMED CONDITION**			
s1_Brown	**A**	**B**	**C**	**D**	**s2_Brown**	**A**	**B**	**C**
OFB	210				OFB	240		
OF		67			OF		86	
O			50		O		72	
OL				6	OL			10
s1_Light	**A**	**B**	**C**		**s2_Light**	**A**	**B**	**C**
O	172				O	175		
OF	165				OF	165		
OFB		83			OFB		80	
OL			38		OL			46
s1_Opaque	**A**	**B**			**s2_Opaque**	**A**	**B**	
OL	185				OL	190		
OF		157			O	174		
O		150			OF	174		
OFB		141			OFB		140	
s1_Translucent	**A**	**B**	**C**		**s2_Translucent**	**A**	**B**	**C**
O	76				O	91		
OF	72				OF	89		
OFB		42			OFB		56	
OL			18		OL			29
s1_Yellow	**A**	**B**	**C**		**s2_Yellow**	**A**	**B**	
OL	260				OL	280		
O		77			OF		65	
OF		64	64		O		62	
OFB			52		OFB		54	
s1_Cereal	**A**	**B**	**C**		**s2_Cereals**	**A**	**B**	**C**
OFB	198				OFB	223		
OF		172			O		195	
O		158	158		OF		186	186
OL			143		OL			164
s1_Mild	**A**	**B**	**C**		**s2_Mild**	**A**	**B**	**C**
OF	170				OF	172		
O	164				O	163	163	
OFB		131			OFB		144	
OL			95		OL			113
s1_Vegetal	**A**	**B**			**s2_Vegetal**	**A**	**B**	**C**
OL	201				OL	212		
OFB		146			OF		163	
O		145			OFB		154	154
OF		143			O			133
s1_Bitter	**A**	**B**			**s2_Bitter**	**A**	**B**	
OL	87				OL	97		
O		23			OF		26	
OF		23			O		22	
OFB		21			OFB		22	
s1_Sour	**A**				**s2_Sour**	**A**	**B**	

O	57		
OF	57		
OFB	48		
OL	48		
s1_Sweet	**A**	**B**	
OFB	123		
O	118		
OF	103		
OL		55	
s1_Legume	**A**	**B**	
OL	151		
OFB		113	
O		108	
OF		97	
s1_Nutty	**A**	**B**	**C**
OFB	150		
OF		122	
O		114	
OL			76
s1_Oat	**A**	**B**	
OF	145		
OFB	124	124	
O		120	
OL		111	
s1_Vegetal Taste	**A**	**B**	
OL	153		
O	130	130	
OFB		128	
OF		122	
s1_Astringent	**A**	**B**	**C**
OL	75		
O		40	
OF		26	26
OFB			19
s1_Gritty	**A**	**B**	**C**
OFB	129		
OF	112	112	
OL		98	98
O			87
s1_Silky	**A**		
OFB	107		
O	89		
OL	89		
OF	86		
s1_Watery	**A**	**B**	
OF	229		
O	224		
OL		202	
OFB		196	

O	97		
OF		75	
OL		65	
OFB		64	
s2_Sweet	**A**	**B**	**C**
OFB	147		
O		124	
OF		108	
OL			63
s2_Legumes	**A**	**B**	**C**
OL	173		
OFB	153	153	
OF		143	
O			80
s2_Nutty	**A**	**B**	**C**
OFB	134		
OF	122		
O		96	
OL			58
s2_Oat	**A**	**B**	**C**
O	195		
OF	186	186	
OFB		169	
OL			142
s1_Vegetal Taste	**A**	**B**	
OL	138		
OFB	134		
OF	130		
O		108	
s2_Astringent	**A**	**B**	
OL	71		
OF		41	
O		35	
OFB		27	
s2_Gritty	**A**	**B**	
OFB	130		
OF	117		
OL		94	
O		82	
s2_Silky	**A**		
OFB	118		
OL	104		
OF	102		
O	96		
s2_Watery	**A**	**B**	
O	232		
OF		205	
OFB		204	
OL		184	

Appendix 3. McNemar Tests for comparing emojis elicited across all beverages

The following table presents the results of the McNemar tests for all emojis tested. Different sub-groups are denominated by capital letters. Values indicate the total number of times the particular attribute was selected for the corresponding beverage. Differences are grouped at 5% significance level.

BLIND CONDITION			**INFORMED CONDITION**		
s1_👏	**A**	**B**	**s2_👏**	**A**	**B**
O	18		OFB	25	
OF	18		OF	22	
OFB	16		O	21	
OL		7	OL		7
s1_😖	**A**	**B**	**s2_😖**	**A**	**B**
OL	55		OL	47	
O		29	O		23
OFB		29	OF		20
OF		27	OFB		20
s1_😟	**A**	**B**	**s2_😟**	**A**	**B**
OL	55		OL	46	
O	54		OFB		29
OF	38	38	O		26
OFB		36	OF		25
s1_😨	**A**	**B**	**s2_😨**	**A**	
OL	29		OL	16	
O		12	O	12	
OFB		9	OF	10	
OF		8	OFB	9	
s1_😎	**A**		**s2_😎**	**A**	**B**
O	18		O	25	
OFB	17		OFB	21	
OF	12		OF	15	15
OL	11		OL		7
s1_😔	**A**		**s2_😔**	**A**	**B**
OL	26		OL	36	
OFB	23		OFB		15
O	17		OF		12
OF	16		O		11
s1_😑	**A**		**s2_😑**	**A**	**B**
OL	43		OL	53	
OF	41		OF		33
OFB	37		O		31
O	32		OFB		28
s1_😱	**A**		**s2_😱**	**A**	
OL	14		OL	15	
OF	10		O	7	
OFB	7		OFB	7	
O	6		OF	6	
s1_😘	**A**		**s2_😘**	**A**	**B**
OFB	12		O	21	
O	10		OF	20	
OF	9		OFB	18	
OL	5		OL		7

s1_👎	A	B	C
OL	70		
O		35	
OFB		26	26
OF			19

s1_👍	A	B	C
OFB	91		
OF	85	85	
O		68	
OL			38

s1_😝	A
O	15
OFB	11
OL	10
OF	9

s1_😜	A	B
O	22	
OFB	16	16
OF		8
OL		8

s1_😉	A
O	19
OF	17
OFB	16
OL	7

s1_😢	A	B
OL	41	
OFB	32	32
O	26	26
OF		21

s1_😳	A
O	28
OFB	21
OL	21
OF	16

s1_😬	A
OFB	81
O	74
OF	72
OL	68

s1_👌	A	B
O	46	
OF	46	
OFB	38	
OL		16

s1_😔	A
OL	21
OF	20
OFB	17
O	16

s1_😩	A
OL	38
O	23

s2_👎	A	B
OL	49	
O		17
OF		15
OFB		13

s2_👍	A	B
OFB	98	
O	84	
OF	82	
OL		40

s2_😝	A
O	15
OFB	12
OL	12
OF	10

s2_😜	A	B
OFB	19	
O	14	
OF	14	
OL		5

s2_😉	A	B
OFB	25	
OF	24	
O	23	
OL		9

s2_😢	A	B
OL	34	
O	31	
OF	26	26
OFB		15

s2_😳	A	B
OL	30	
OF	20	20
OFB	20	20
O		13

s2_😬	A	B
OL	81	
OF	78	
O	69	
OFB		46

s2_👌	A	B
OFB	55	
O	49	
OF	48	
OL		20

s2_😔	A	B
OL	35	
OF	24	24
O		19
OFB		17

s2_😩	A	B
OL	40	
O		20

OFB	23	
OF	22	
s1_😖	**A**	**B**
OL	68	
OFB		20
O		19
OF		17
s1_😍	**A**	**B**
OFB	23	
O	20	
OF	16	16
OL		9
s1_😊	**A**	**B**
OFB	78	
OF	75	
O	67	
OL		37
s1_😄	**A**	**B**
OF	36	
OFB	29	
O	26	26
OL		14
s1_😉	**A**	**B**
O	40	
OF	35	35
OFB	31	31
OL		21

OFB		16
OF		15
s2_😖	**A**	**B**
OL	54	
O		22
OF		15
OFB		14
s2_😍	**A**	**B**
O	34	
OFB	31	
OF	29	
OL		9
s2_😊	**A**	**B**
OFB	84	
OF	72	
O	68	
OL		25
s2_😄	**A**	**B**
O	42	
OF	41	
OFB	37	
OL		16
s2_😉	**A**	**B**
OF	46	
OFB	45	
O	34	
OL		18