Health versus environmental benefits
Does additional information influence consumer acceptance of pulse-based spreads?

Henn, Katharina; Reinbach, Helene Christine; Olsen, Søren Bøye; Aaslyng, Margit Dall; Laugesen, Susanne Margarete Bølling; Bredie, Wender L. P.

Published in:
Journal of Food Science

DOI:
10.1111/1750-3841.16471

Publication date:
2023

Document version
Publisher’s PDF, also known as Version of record

Document license:
CC BY-NC

Citation for published version (APA):
Health versus environmental benefits: Does additional information influence consumer acceptance of pulse-based spreads?

Katharina Henn¹ | Helene Christine Reinbach¹ | Søren Bøye Olsen² | Margit Dall Aaslyng³ | Susanne Margarete Bølling Laugesen³ | Wender L. P. Bredie¹

¹Section for Food Design and Consumer Behaviour, Department of Food Science, University of Copenhagen, Frederiksberg, Denmark
²Section for Environment and Natural Resources, Department of Food and Resource Economics, University of Copenhagen, Frederiksberg, Denmark
³Nutrition and Health, Centre for Nutrition, Rehabilitation and Midwifery, University College Absalon, Slagelse, Denmark

Correspondence
Katharina Henn and Wender L. P. Bredie, Section for Food Design and Consumer Behaviour, Department of Food Science, University of Copenhagen, Rolighedsvej 26, 1958 Frederiksberg C, Denmark. Email: katharina.henn@food.ku.dk, wb@food.ku.dk

Funding information
H2020 Marie Skłodowska-Curie Actions

Abstract
Despite the known health benefits and the potential for substituting less environmentally sustainable consumed foods such as meat, the current intake of pulses in developed countries remains less than recommended. Barriers are related to sensory characteristics and lack of knowledge about preparation, while drivers of environmental benefits are intangible. The aim of this study was to investigate the effect of additional information about health or environmental benefits of pulses on the acceptance of novel pulse-based products from chickpeas, black beans, and faba beans. Perceptions of these pulse-based spreads in a blind and informed stage were assessed with 202 consumers in urban and suburban areas of Denmark. In general, the familiar chickpea spread followed by the relatively most unfamiliar black bean spread was liked the most. Only for these two products, additional information increased hedonic perception, regardless of the context (health or environmental benefits). If consumers did not like the spread, as found for the faba bean spread, providing additional information did not significantly alter this perception. Participants’ preferences and willingness to pay (WTP) in a discrete choice experiment corresponded to hedonic scores, whereas providing additional information increased the WTP. These findings suggest that extrinsic cues such as health or environmental benefits may only be useful in products with an acceptable baseline taste profile. Moreover, black beans might be investigated as a promising source for further product development due to their acceptance by consumers besides being the comparably most unfamiliar pulse type.

KEYWORDS
context effects, discrete choice experiment, environmental information, food acceptance, pulses, willingness to pay
1 | INTRODUCTION

The combination of a growing world population and a modern diet containing large quantities of animal-based foods causes food security and environmental sustainability concerns. While the EAT-Lancet commission describes a sustainable diet to prevent health and environmental damage, a large gap between the recommended intake of plant-based foods and the actual dietary pattern is observed (Willett et al., 2019). Moving toward a more sustainable diet, including an increased consumption of plant-based foods, is challenged by well-established social and cultural norms, sensory preferences, preparation knowledge, digestion concerns, and culinary traditions (Aschemann-Witzel et al., 2021; Hartmann & Siegrist, 2017; Henn, Goddyn, et al., 2022; Lea et al., 2005).

Pulses are the dried edible seeds harvested from the pod of a leguminous plant, whereby peas, beans, lentils, and chickpeas represent the commonly known pulse types (Malcolmson & Sissons, 2017). Pulses support the three Ps of sustainability—people, planet, and profit (Didinger & Thompson, 2020; Wognum et al., 2011) with large benefits toward personal (Carbas et al., 2021; Curran, 2012; McCrory et al., 2010; Mudryj et al., 2014; Rebello et al., 2014) and environmental health (Ferreira et al., 2021; Harwatt et al., 2017; Sabaté et al., 2015; Willett et al., 2019). Yet, pulses are underutilized as a human food source especially in Europe (Asif et al., 2013; Didinger & Thompson, 2020; Henn, Zhang, et al., 2022) due to barriers of sensory and preparation properties as well as digestive problems such as bloating and flatulence (Doma et al., 2019; Henn, Goddyn, et al., 2022). Besides, consumers seem to underestimate the benefits of plant-based foods to promote sustainable development (Hartmann et al., 2022; Henn, Zhang, et al., 2022; Tobler et al., 2011a; Vanhonacker et al., 2013). While segments of the society are willing to replace animal-based foods with plant-based alternatives, such as pulses, it has become apparent that these alternatives must be innovative, convenient, and organic for consumers from different European countries (Henn, Bøyé Olsen, et al., 2022).

Previous research has shown that an adoption of new products can be facilitated by using familiar products as a base (Didinger & Thompson, 2020; Pelchat & Pliner, 1995). Additional information can aid to foster successful introduction of new products, as purchase intention and quality perception are positively affected (Lemken et al., 2017; Palmer et al., 2018). Thereby, consumers form expectations about the properties of the product based on additional information (Banovic et al., 2022). These expectations may subsequently affect the actual liking of the sensory properties during tasting due to assimilation or contrast effects (Anderson, 1973; Deliza & MacFie, 1996; Wilcox et al., 2011). Including environmental motives alone might not be the strongest persuasion to encourage consumption of plant-based foods (Tobler et al., 2011b). Therefore, clear environmental messages together with health claims of personal relevance could be most beneficial (Farrell et al., 2019; Lemken et al., 2017).

Hence, the aim of this study was to examine if additional information about health and environmental benefits could increase acceptance of new products from pulses. The objective was to first investigate consumers’ familiarity and liking of products from chickpeas, black beans, and faba beans, which were prepared in a similar way as a currently available hummus. Furthermore, expectations (extrinsic cues) and experienced liking (intrinsic cues) were compared to further understand consumers’ acceptance. Extrinsic cues were altered by additional information on the products’ health or environmental benefits, whereby intrinsic cues referred to the pulse type (including taste, appearance, etc.). Thereby, it was hypothesized that additional information will have a greater influence on expected liking of unfamiliar, new products, that is, faba beans. Another research question built on the importance of environmental benefits as a driver of consumption. Previous consumption of pulses has been determined to be driven by health reasons, while environmental benefits play a minor role (Henn, Goddyn, et al., 2022). By providing additional information on both drivers in this study, explorations on whether environmental benefits played a minor role due to a lack of knowledge about these or whether knowledge exists, but the benefits are not considered as a driver, were made. Consumers’ acceptance of pulse-based spreads according to additional information was studied in two locations in Denmark. Investigating urban and suburban areas was based on the objective that attitudes, perceptions, or consumption patterns might be different outside the capital city of Denmark. Besides location, influence of sociodemographic characteristics and attitudes, for example, health concern, and their role as modifiers of the information effect was investigated. Lastly, health and environmental benefits were combined with origin and price (extrinsic cues) and its effect on consumers’ choice and willingness to pay (WTP) was compared to that of the intrinsic cues (i.e., pulse type or taste of the spread) in a discrete choice experiment (DCE).

2 | METHODOLOGY

2.1 | Experimental design

Participants tasted three pulse-based spreads without or with additional information on health, environment, or
FIGURE 1 Schematic experimental procedure of the consumer test

both (in total, 12 samples per participant in three rounds). To consider pulses with different familiarity, three types were chosen according to being unfamiliar (faba beans), slightly familiar (black beans), and very familiar (chickpeas). This familiarity for consumers in Denmark was previously identified by Henn, Zhang, et al. (2022). The study was carried out over multiple sessions in December 2021 in Copenhagen (urban) and Slagelse (suburban). During a session, each participant was sitting in an individual booth lit with white light and equipped with an iPad, spoon, napkin, and tap water. SurveyMonkey (Momentive Europe UC, Dublin, Ireland, 2020) was used for data acquisition, whereby the language of the questionnaire could be set according to the participants’ preferences (Danish or English). The experimental procedure is depicted in Figure 1.

Just before the tasting session, participants received an information sheet related to the conditions of the study and signed a consent form. Each session lasted 60 min and started with an introduction to the tasting in Danish and English. The introduction explained on the tasting rounds and was standardized for all sessions. It was emphasized that there were no “right” or “wrong” answers, that a subjective scale was shown that could be used according to an own reference point, and that participants needed to rinse their mouth in between samples. Samples were served on cardboard trays and labeled with a three-digit code. In total, each session was split into three stages, with a blind tasting and two informed tastings. In between each stage, a short washout period was included consisting of questions on sociodemographics, eating habits, and attitudes. The order of stages was not randomized. Within each stage, the serving order was randomized per session. After completion, participants received a compensation in form of a goodie bag.

2.1.1 Stage 1: Blind tasting

The first three samples without additional information were served in a randomized order, whereby participants had to type the three-digit code, respectively. Before tasting a sample, participants were asked to rate their familiarity with the product and to indicate their expected liking based on visual properties of the sample. Familiarity was formulated as a single-choice question with five ordered categories ranging from “I don’t recognize the product” to “I regularly eat the product” similar to Bäckström et al. (2004). Next, participants were asked to taste the product and score their degree of liking (experienced liking). Expected and experienced liking was measured on a 100-mm continuous hedonic scale (Pimentel et al., 2016) with a preset midpoint and two end points (“not at all” and “extremely”), whereby participants could not see the exact score. Sociodemographic questions including age, gender, residence, living situation, education, income, and food habits followed the three tastings, additionally functioning as a washout period in between the stages.
2.1.2 | Stage 2: First informed tasting with health or environmental benefits

Additional information either on health or environmental benefits was provided in printed form on the serving trays. Participants were served six samples in a totally randomized order, according to three spreads and two information assessed. The questionnaire demanded to read this information first and to rate expected and experienced liking after while keeping the information in mind. After this stage, participants had to fill in questions about nutritional knowledge (Alexander & Tepper, 1995), health concern (Kähkönen et al., 1997; Lesáková, 2018), environmental concern (Schultz, 2001), and variety seeking (van Trijp & Steenkamp, 1992).

2.1.3 | Stage 3: Second informed tasting with combined benefits

Similar to stage 2, additional information on the tray was presented, while health and environmental benefits were combined for this stage. Expected liking before tasting and experienced liking after tasting had to be rated for three samples, which were presented in a randomized order.

2.1.4 | Stage 4: DCE

Finally, participants performed a DCE of three alternatives, differing in spread type, additional information, origin, and price to assess preferences and WTP.

2.2 | Subjects

Overall, 202 participants aged between 18 and 66 years took part in the study. The consumers were selected according to their pulse consumption habits and area of residence. Participants who consumed pulses “(almost) every day,” hence not subject to promoting increased consumption, were excluded. A large part lived in the capital area of Copenhagen (n = 141), including a considerable segment of expats living in Denmark, and was recruited about 4 weeks prior to the experiment via posters shared on social media, on campus, and with the internal consumer panel. During the recruitment stage, an online questionnaire collected participants’ sociodemographics and consumption frequency of pulses. Further participants (n = 61) were recruited in a smaller city outside the capital area, Slagelse. These participants were recruited around the University College Absalon, whereby volunteers were asked about their sociodemographics and consumption frequency in person. Subjects gave their consent to participate in the recruitment. During the recruitment in Copenhagen and Slagelse, selection quota for age (18–30/30–65 = 50/50) and gender (male/female = 50/50) were used. Demographics and food consumption behavior of study participants across locations are presented in the Supporting Information. The total median age was 28 (24–40) years, whereby more women participated in Slagelse (73.8%) than in Copenhagen (63.8%). Significant differences were observed in terms of food consumption frequency across locations, especially a more frequent meat consumption and less frequent plant-based consumption in Slagelse.

2.3 | Products

Faba beans, black beans, and chickpeas were utilized from canned produce and blended to a spread, similar to a hummus, with additional water, olive oil, citrus juice, tahini, and cumin. The amount of water was adjusted depending on the creaminess of the pulse types; hence, half the amount was added to the black bean spread. A total of 10 g of the spread was filled into 50-ml plastic cups with a lid, labeled with a three-digit code, and stored at fridge temperature (7°C) until use, but not longer than 72 h. Spreads were transferred to a room-temperature fridge (21°C) 15 min prior to the respective tasting round.

2.3.1 | Additional information on the samples

After a blind tasting, participants were presented with samples including additional information either on health or environmental benefits in a second round. The statement on health benefits was formulated as follows: “This product is especially good for your health. The special production ensures that the product contains an especially high amount of vitamins, high quality proteins and iron. Regular consumption of the product can furthermore reduce the risk of heart disease and other serious diseases.” On the other hand, information on environmental benefits was formulated as “This product is especially good for our planet. The farmer has avoided pesticides and fertilizer in a very environmentally friendly production. The cultivated plants also help to reduce greenhouse gases, improve soil fertility and feeding other crops that grow alongside them.” These health and environmental benefits of pulses have been highlighted by various authors (e.g., Carbas et al., 2021; Ferreira et al., 2021). In a third round, a combination of information on health and environmental benefits was provided to participants. Information was printed, served together with the
sample, and translated to English or Danish according to a participant’s preference.

### 2.4 Discrete choice experiment

A DCE followed the tasting and was designed to elicit participants’ preferences and WTP for different types of spreads. The DCE\(^1\) approach was selected instead of rating-based conjoint due to its greater similarity with actual market behavior (Ares et al., 2010), which may create increased external validity of the findings (Elrod et al., 1992). A scenario description was provided, whereby participants were told to imagine a shopping situation in which they would buy 200 g of a hummus. Participants were then shown choice sets in which they had to choose between different spreads made from different types of pulses, specifically either chickpea, black bean, or faba bean (three levels). Besides differing in the type of pulse used, the alternative spreads differed in four other attributes, including (1) whether or not a label signaling additional information on health benefits was provided, (2) whether or not a label signaling additional information on environmental benefits was provided, (3) whether or not the product was locally produced (in Denmark), and (4) a price taking one of four levels (20 DKK, 25 DKK, 33 DKK, and 45 DKK; 10 DKK ≈ 1.30 €). As a relation, a conventional or organic hummus of 200 g size is priced at 20–30 DKK in Denmark. Each choice set consisted of three alternatives and an opt-out possibility defined as “none of these.” A fractional factorial design was used to identify the 12 different choice sets.

### 2.5 Data analysis

Statistical analyses on the tasting measures were performed using IBM SPSS Statistics (version 28.0, SPSS Inc., Chicago, IL, 2021). Kurtosis, and skewness were not given and the inspection of the histograms indicated that normal distribution of data on liking was not violated. Therefore, data was treated as normally distributed, even though a Shapiro-Wilk test found nonnormality. A general linear model (GLM) suggested that familiarity and liking of the different spreads did not show different trends between locations (location × product interaction), regardless of the presence of additional information (location × information interaction). Therefore, the total sample was used for further analyses without differentiations across geographical location. The same GLM was used to study the interaction of liking and information dependent on age, gender, and diet as in-between subject effects. For this purpose, age was used as categories (\( \leq 30/\geq 30\)), and “other” forms of diet were excluded. Paired sample \( t \)-test or repeated measures ANOVA was used to determine differences between the respective spreads in terms of familiarity, expected liking, and experienced liking as well as the effect of additional information in stages 1–3. Post hoc Bonferroni correction was applied if multiple comparisons were made.

Participants’ behavioral characteristics were assessed using validated scales. Cronbach’s \( \alpha \) of the scales (5-point Likert scale) on health and environmental concern and variety seeking were acceptable (0.62, 0.87, and 0.86, respectively). Mean values for the summed nutritional knowledge (Y/N), health, and environmental concern and the summed variety seeking were calculated. Additionally, variety seeking was classified as a low, medium, and high tendency according to van Trijp and Steenkamp (1992). Differences across locations were solely observed for the variety seeking characteristic. The effect of behavioral characteristics on familiarity and liking in a blind or informed stage was assessed using Spearman’s rank correlation, due to nonnormally distributed data, without differentiating between the location of participants.

Choices made in the DCE were analyzed using a mixed logit model. The software package mlogit in R (version 4.1.3, R Foundation for Statistical Computing Inc., Vienna Austria, 2022) was used for this purpose. The mixed logit model, which allows identification of preference heterogeneity among participants, was used for obtaining parameter estimates of attribute levels, and an alternative specific constant was defined for the opt-out alternative. For the effect-coded attribute “product,” the chickpea spread was used as a reference level and parameter estimates for the two other “product” levels were thus estimated relative to this reference level. Attributes of health information, environmental information, and origin were dummy coded, while the price attribute was specified as a continuous variable. Additionally, the relative importance of each attribute was estimated to compare its relative effect on the choice of a spread. Attribute estimates of a DCE cannot be interpreted as relative importance as such due to the lack of commensurable measurement units (Lancsar et al., 2007). The partial log-likelihood method was used instead, whereby the relative importance was estimated based upon how much each attribute contributed to the overall log-likelihood of the choice model (Crough & Louviere, 2004; Rusmevichientong et al., 2021). A \( p \)-value < 0.05 was considered as statistically significant for all analyses. Data are presented as mean value and standard error, if not otherwise stated.

---

\(^1\)The applied approach of DCE is sometimes referred to as choice-based conjoint analysis. Yet, Louviere et al. (2010) highlight that this term is potentially misleading as DCE and conjoint analysis are based on different theories.
3 | RESULTS

3.1 | Liking of spreads as a function of familiarity

Significant differences were found for consumers’ familiarity, expected liking, and experienced liking of the different spreads based on chickpeas, black beans, or faba beans (Figure 2). The chickpea spread was the most familiar and most liked type of product. The average familiarity with chickpea spreads \((M = 3.2 \pm 0.1)\) indicated that consumers had tasted the product before, while the faba bean spread was recognized \((M = 2.0 \pm 0.09)\) and the black bean spread was not recognized by a large part of the consumers \((M = 1.5 \pm 0.07)\) according to the applied scale (Bäckström et al., 2004). Additional Pearson’s product–moment correlation analysis showed an influence of familiarity on expected liking of all pulse-based products, especially for the chickpea spread \((r = 0.60, p < 0.001)\); black beans: \(r = 0.34, p < 0.001\); faba beans: \(r = 0.39, p < 0.001\). For all pulse-based spreads, expected liking significantly differed from experienced liking with the largest incongruency for the faba bean spread \((\Delta = 14.2 \pm 1.8; t(201) = 7.74, p < 0.001)\). Even though consumers indicated to be more familiar with the faba bean spread and thus expected to like it more than the black bean spread, the latter was rated significantly higher in experienced liking (Figure 2). No significant interaction of familiarity, expectation, or liking of the spreads was determined using geographical location, age, gender, and diet as a factor in a GLM.

3.2 | Effect of information on liking on pulse-based spreads

The effect of information differed across tested products. For most samples, regardless of the context of information, negative disconfirmation occurred, that is, expected liking was significantly higher than actual liking during the blind stage. For the case of chickpea spreads, negative disconfirmation (worse than expected) occurred when providing information on environmental benefits \((\Delta = 4.6 \pm 1.6; t(201) = 2.86, p = 0.002)\) and both health and environmental benefits \((\Delta = 5.4 \pm 1.6; t(201) = 3.31, p < 0.001)\). A similar observation was made for the black bean spread with higher expectations for environmental information \((\Delta = 3.9 \pm 1.6; t(201) = 2.38, p = 0.018)\) and a combined information of both health and environmental benefits \((\Delta = 5.3 \pm 1.6; t(201) = 3.35, p < 0.001)\) relative to blind liking. The largest negative disconfirmation was described for the faba bean spread for information on health \((\Delta = 18.0 \pm 1.8; t(201) = 9.86, p < 0.001)\), environment \((\Delta = 18.1 \pm 1.9; t(201) = 9.71, p < 0.001)\), and both information \((\Delta = 17.3 \pm 1.8; t(201) = 9.86, p < 0.001)\). All disconfirmation occurrences of the three spreads can be explained by the assimilation theory from Anderson (1973), which describes that consumers adjust experienced liking close to expectations if expectations are disconfirmed from blind liking. However, in certain cases, assimilation of liking and expectations is not completely achieved, meaning that consumers do not completely adjust actual liking toward their expectations (Lange et al., 1998; Siret & Issanchou, 2000; Stolzenbach et al., 2013). This effect was observed for the faba bean spread, which participants liked less compared to their expectations. Thereby, sensory characteristics, that is, disliking the faba bean spread, could have contributed to the incomplete assimilation, which has been observed previously (Caporale & Monteleone, 2004; di Monaco et al., 2004; Hersleth et al., 2011; Napolitano et al., 2007; Siret & Issanchou, 2000; Stolzenbach et al., 2013; Varela et al., 2010).

Information could significantly increase actual liking of the spreads throughout the informed stages (Figure 3), with varying effect per spread. However, interactions of location, age, gender, and diet with the effect of information were found to be insignificant. For the chickpea spread, additional information on health \((M_L = 72.0 \pm 1.5)\),
FIGURE 3 Influence of information about health, environmental, and both benefits on the expected (___) and experienced (,...) liking of a chickpea (a), black bean (b), and faba bean (c) spread (N = 202) on a hedonic scale. Data shown as mean \( \pm \) SE liking (0–100) for all stages. Different superscripts indicate differences between information stages. \( \Delta \) shows the difference between expected and experienced liking. Paired sample \( t \)-test was conducted to determine significant differences between expected versus experienced liking. Differences along information stages were determined with a repeated measures ANOVA using a post hoc Bonferroni correction for multiple comparisons. \( N = 201 \) for expected and experienced liking of the faba bean spread with information on environmental benefits.
environment \((M_L = 73.5 \pm 1.5)\), or both \((M_L = 73.8.1 \pm 1.4)\) contributed to a significant increase in experienced liking compared to blind liking \((M_L = 63.7 \pm 1.6)\). Inverted behavior comparing expectations and liking per stage was observed for the blind (expectation > liking) compared to the informed stages (expectation < liking), whereby in this case actual liking significantly increased and expectations remained constant as depicted in Figure 3a. A slightly different pattern is depicted for the observations of consumers' liking of the black bean spread. A significant increase in expected (E) and actual liking (L) of black beans was observed from the blind stage \((M_E = 44.5 \pm 1.5; M_L = 52.4 \pm 1.7)\) to the first informed stage, regardless of the context regarding health \((M_E = 54.5 \pm 1.7; M_L = 57.5 \pm 1.7)\) or environmental benefits \((M_E = 56.3 \pm 1.7; M_L = 57.1 \pm 1.8)\). Furthermore, a combined information led to another significant increase of actual liking \((M_L = 60.1 \pm 1.7)\). Lastly, no significant effect of information on liking of the faba bean spread was found, regardless of whether information on health, environment, or both was given. However, expected and experienced liking of the faba bean spread was largely negatively diverting in all stages with a significant decrease of liking after tasting between 14.2 and 16.0 \(p < 0.001\) points on a scale from 0 to 100. Hence, negative sensory perception overruled additional information, and information solely affected liking of products that were accepted in the blind liking stage.

### 3.3 Influence of behavioral characteristics on perception of the spreads

#### 3.3.1 Differences in characteristics across locations

Participants were classified with a medium nutritional knowledge, giving a correct answer to about 60% of the questions \((M = 5.9 \pm 0.1)\). The overall nutritional knowledge did not differ significantly between locations \((p = 0.204)\). Health and environmental concerns were assessed on a 5-point Likert scale and found to be moderate for health \((M = 3.7 \pm 0.03)\) and high for environmental concern \((M = 4.2 \pm 0.04)\). A paired sample t-test between health and environmental concern confirmed participants’ higher importance of the latter \((\Delta = -0.5; t(201) = -10.64, p < 0.001)\). Furthermore, egoistic (E), altruistic (A), and biospheric (B) environmental concerns (Schultz, 2001) were determined. Participants’ agreement with egoistic concerns outweighed altruistic and biospheric environmental concerns \((\Delta_{E-A} = 0.4 \pm 0.06, t(201) = -6.82, p < 0.001; \Delta_{E-B} = 0.6 \pm 0.07, t(201) = -8.65, p < 0.001; \Delta_{A-B} = 0.2 \pm 0.05, t(201) = 3.70, p < 0.001)\). Environmental and health concern measures did not differ across locations. Apart from knowledge and concern, participants’ variety seeking tendency was determined, whereby participants were primarily medium variety seekers (48%, VAR-SEEK range 26–34). A significantly higher proportion of participants from Slagelse (32%) were found to have low variety seeking tendency compared to participants from Copenhagen (9%) \((\chi^2(2) = 17.33, p < 0.001)\).

#### 3.3.2 Influence on familiarity and liking of spreads from different pulse types

The influence of participant’s knowledge, concern, and behavior on perceived familiarity and liking of the spreads differed across the types of products (Table 1). In general, positive but rather low correlation coefficients were observed. Focusing on significant, large correlations, familiarity with chickpeas was related to variety seeking, whereas faba bean familiarity was correlated with health concern. A similar pattern was determined when reflecting upon the expected liking scenario. Additionally, increased environmental concern was found to increase expected liking of chickpea and faba bean spreads, while nutritional knowledge and variety seeking led to higher expected liking of the black bean spread. Overall, perceptions of the chickpea spread were positively correlated with variety seeking, while health as well as environmental concern had a positive impact on the liking of the faba bean-based spreads.

#### 3.3.3 Effect of additional information

The effect of additional information on liking of pulse-based spreads was not correlated with participants’ concerns toward health and environment, nutritional knowledge, and variety seeking behavior (Table 1). Apart from a negative correlation between nutritional knowledge and the effect of health information on the liking of faba bean spreads, no significant correlations at a p-value threshold of 0.05 were observed.

### 3.4 Preference and WTP for pulse-based spreads

Table 2 displays mean parameter and WTP estimates as well as relative importance for each attribute level relative to the baseline as determined using a mixed logit model. Participants generally tended to choose one of the spread alternatives rather than the opt-out, irrespective of

\[ ^2 \text{In this case if } r_5 \geq 0.2, p \leq 0.05. \]
## TABLE 1 Correlation coefficient between knowledge and attitudes on familiarity, expected liking, and experienced liking of different pulse-based spreads in the blind and informed stage (N = 202)

<table>
<thead>
<tr>
<th></th>
<th>Nutritional knowledge</th>
<th>Health concern</th>
<th>Environmental concern</th>
<th>Variety seeking</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blind stage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiarity</td>
<td>C 0.15*</td>
<td>0.07</td>
<td>0.16*</td>
<td>0.26**</td>
</tr>
<tr>
<td></td>
<td>B 0.07</td>
<td>0.08</td>
<td>0.16*</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>F 0.05</td>
<td>0.25**</td>
<td>0.06</td>
<td>0.08</td>
</tr>
<tr>
<td>Expected liking</td>
<td>C 0.07</td>
<td>0.07</td>
<td>0.24**</td>
<td>0.28**</td>
</tr>
<tr>
<td></td>
<td>B 0.21**</td>
<td>−0.02</td>
<td>0.14*</td>
<td>0.20**</td>
</tr>
<tr>
<td></td>
<td>F 0.04</td>
<td>0.20**</td>
<td>0.22**</td>
<td>0.14*</td>
</tr>
<tr>
<td>Experienced liking</td>
<td>C −0.02</td>
<td>0</td>
<td>0.17*</td>
<td>0.16*</td>
</tr>
<tr>
<td></td>
<td>B 0.13</td>
<td>0.12</td>
<td>0.08</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>F 0</td>
<td>0.02</td>
<td>0.15*</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Informed stage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>C −0.06</td>
<td>0.12</td>
<td>0.02</td>
<td>−0.02</td>
</tr>
<tr>
<td></td>
<td>B 0.08</td>
<td>0.06</td>
<td>0.05</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>F −0.18*</td>
<td>0.02</td>
<td>−0.12</td>
<td>−0.05</td>
</tr>
<tr>
<td>Environment</td>
<td>C −0.09</td>
<td>0.08</td>
<td>0.06</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>B −0.02</td>
<td>0.02</td>
<td>0.12</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>F −0.06</td>
<td>−0.04</td>
<td>−0.07</td>
<td>0</td>
</tr>
<tr>
<td>Both</td>
<td>C −0.03</td>
<td>0.04</td>
<td>0</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>B 0.06</td>
<td>0.01</td>
<td>0.02</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>F −0.06</td>
<td>−0.01</td>
<td>−0.13</td>
<td>−0.04</td>
</tr>
</tbody>
</table>

Note: Data are presented as Spearman’s rank correlation coefficients ($r_S$) and significant values are flagged. Abbreviations: B, black bean; C, chickpea; F, faba bean.

*For correlation analysis, the difference in experienced liking with information was used ($\Delta$experienced-blind).

*N = 201 due to missing values.

*Correlation is significant at the $\alpha = 0.05$ level (two-tailed).

**Correlation is significant at the $\alpha = 0.01$ level (two-tailed).

The attributes according to a highly negative alternative-specific constant associated with the opt-out. However, participants were less likely to choose a spread made from black beans or faba beans compared to a spread made from chickpeas, which was used as the reference for pulse types in the model. In effect, mean WTP made from black bean and faba bean decreased by 12–13 DKK relative to the chickpea spread. Information on health or environment (relative to no information) positively influenced the probability for choosing a certain spread and increased the mean WTP by about 6–8 DKK, being independent of other attributes, with the highest increase for health information. Similar findings were observed for local origin, which increased the mean parameter estimate of choosing an alternative originating from Denmark. The WTP for local origin increased by 6.5 DKK. A price increase of the spread led to a lower preference for the respective alternative. The relative importance of the respective attributes suggested that price was the most important driver for the choice of a spread, accounting for 45% of the variance in the model. The type of pulse was the second most influential attribute, accounting for 29% of the variance in the final model. The labels concerning additional health (10%) or environment effects (6%) had the relatively lowest importance in the model, both slightly lower than the impact of the origin attribute (11%).

## 4 DISCUSSION

### 4.1 The role of familiarity on the effect of additional information

Spreads from chickpeas, black beans, and faba beans were chosen to represent pulse-based products differing in familiarity, decreasing in the stated order. When providing the spreads to participants, a different order in familiarity was observed. The faba bean spread seemed to be recognized, while the spread from black beans was not recognized. Thereby, participants did not know about the ingredients of each spread and could have also associated the faba bean spread to be made of peas, which are rather common in Denmark (Henn, Zhang, et al., 2022). Familiarity and liking of the different spreads were merely correlated with participants’ attitudes. Variety seekers may...
already be attached to products such as hummus, which are entering the Danish market successfully (Andersen et al., 2022). The positive correlation between health and environmental concern and the acceptance of the faba bean spread could result from its green color as a typical indication for “green” and healthy food (Seo & Scammon, 2017).

In this study, the effect of information was found to be a function of liking sensory characteristics rather than familiarity, shown by a synergetic, positive effect of product type and information on liking for the chickpea and black bean spreads. However, expectations in the blind stage were strongly influenced by familiarity, that is, previous experience of this spread or a similar spread resulted in expectations to like the spread again. The spread made of chickpeas was the most familiar spread, and expectations were higher for the blind stage compared to other spreads. In accordance, the chickpea spread was the most liked spread in all stages. Contrary to the hypothesis, the black bean spread was not recognized, evoking comparably low expectations among participants. However, experienced liking surpassed expected liking for the blind stage, with a constant increase according to additional information on the benefits provided together with the sample. Furthermore, the black bean spread, yet uncommon, was significantly more liked than the faba bean spread. Participants particularly disliked the spread made of faba beans, with an average hedonic perception below neutral in all tasting stages. Interesting to note is that expectations to like the faba bean spread remained high throughout tasting stages, indicating that participants did not suspect to taste the same spreads repeatedly. However, additional information on health and/or environmental benefits of the faba bean spread could not alter liking. Hence, for the case of sensory deficits, intrinsic properties outweighed additional extrinsic cues. Sensory quality is known to be a major driver of food choice, and a range of previous research revealed the importance of sensory attributes over extrinsic cues in hedonic perception (Brečić et al., 2017; Chonpracha et al., 2020; Napolitano et al., 2007; Oliveira et al., 2017; Szybillo & Jacoby, 1974; Vázquez-Araújo et al., 2012). Previously, additional information on the product’s benefits was used to increase acceptance of new, unfamiliar, plant-based alternatives (Moon et al., 2011; Mora et al., 2020; Saint-Eve et al., 2021). In this study, additional information on health and environmental benefits did not have the most significant effect on perceived liking of unfamiliar, new products, but only on the sensorially appealing products, that is, black beans and chickpeas.

4.2 The neglect of environmental benefits—Conscious or knowledge gap?

Health has previously been identified as the major driver for pulse consumption, while reasons related to environmental benefits and sustainability played a tangential role (Henn, Goddyn, et al., 2022). As this importance of drivers was determined as part of an online survey, it is unclear whether this behavior is conscious or due to a lack of knowledge. During the tasting, the dominance of health benefits on increasing the liking was not confirmed—health and environmental benefits equally increased liking of the spreads. Furthermore, negative disconfirmation of expectations by environmental information or a combination of both was observed, that is, the blind product performance was found to be worse than the expectation evoked by additional information on environmental benefits. Hence, the hypothesis that environmental benefits

<table>
<thead>
<tr>
<th>Attribute level</th>
<th>Mean parameter estimates</th>
<th>Mean WTP estimates (DKK)</th>
<th>Relative importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td></td>
<td></td>
<td>29%</td>
</tr>
<tr>
<td>Black bean</td>
<td>−1.500 (0.110)***</td>
<td>−12.369 (1.699)</td>
<td></td>
</tr>
<tr>
<td>Faba bean</td>
<td>−1.607 (0.107)***</td>
<td>−13.257 (1.691)</td>
<td></td>
</tr>
<tr>
<td>Health information</td>
<td>0.957 (0.071)***</td>
<td>7.893 (1.141)</td>
<td>10%</td>
</tr>
<tr>
<td>Environmental information</td>
<td>0.739 (0.077)***</td>
<td>6.095 (1.201)</td>
<td>6%</td>
</tr>
<tr>
<td>Local origin</td>
<td>0.784 (0.075)***</td>
<td>6.469 (1.197)</td>
<td></td>
</tr>
<tr>
<td>Price</td>
<td>−0.121 (0.005)***</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>Alternative-specific constant (opt-out)</td>
<td>−4.171 (0.166)***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Standard errors in brackets.

***p < 0.001
are consciously ignored was disproved. Instead, these findings showed that participants were unaware about pulses’ environmental benefits and only additional information could provide sufficient knowledge. Similarly, environmental messages, reflecting collective benefits, were found to increase liking to the same extent as messages relating to personal health benefits, with a combination of both achieving the highest perceived value of legumes (Lemken et al., 2017). While consumers’ unawareness of environmental benefits was observed previously (Hartmann et al., 2022), a recent study by Röös et al. (2022) identified consumers knowing about the environmental impact caused by meat and the health benefits of legume-based products. Furthermore, environmental impact was an important driver to increase legume consumption among the Swedish participants, yet to a lower extent than healthiness and taste (Röös et al., 2022). In this study, a combination of both drivers intensified liking of the black bean spread but not of the chickpea spread. Thus, it could be assumed that for novel, uncommon products, a combination would be beneficial, whereas the kind of information is rather less decisive for common products.

In addition to the apparent lack of knowledge about the environmental benefits of pulses, study participants expressed stronger environmental concern than health concern. Both were correlated with the liking of the faba bean spread. The green faba bean spread could have been associated with healthy, environmentally friendly food, whereby green color is often used for marketing ecotags, environmental claims, or as a packaging color for “green” food (Lin & Chang, 2012; Luchs et al., 2010; Seo & Scammon, 2017; Thøgersen et al., 2010). Scoring high on the variety seeking scale related to a positive perception of the chickpea spread. It could be assumed that participants who sought variety might have previously been exposed with chickpea spreads, inducing a higher liking score possibly due to repeated tasting. Next to consumers’ attitudes, sociodemographic characteristics were not interacting with the effect of information. Hence, additional information on health or environmental benefits to increase acceptance of new pulse-based products may be used for all groups in Denmark regardless of age, gender, or diet.

4.3 Preference for new products from pulses

In the DCE, participants had to choose between alternatives with varying intrinsic and extrinsic properties. Intrinsic properties concerned the type of pulse used for the spread, and extrinsic properties related to origin, price, and health and environmental labels. Participants preferred the chickpea spread over spreads made from black beans or faba beans. Hence, WTP was lower for the black bean and faba bean spread. This was found to be reflected by the hedonic scores, similar to what has been found in previous studies (Roosen et al., 2007; Saint-Eve et al., 2021). Hence, higher liking during the tasting sessions was linked with a stronger preference for the spread in the DCE, regardless of the origin and the context of the labels. In other words, product type (sensory properties) as the intrinsic cue was of major importance for the choice of a respective product, which is typically the tipping point for consumer experience (Arvola et al., 1999). Consumption of plant-based foods was previously found to be greatly impacted by appealing sensory properties (Appleton et al., 2019). In parallel, price was, together with the type of pulse, driving the choice of an alternative. Even if the relative importance of health and environmental labels as well as local origin was low, these labels triggered a significant increase of participants’ WTP of about 6–8 DKK (~1 €). In contrast to the hedonic evaluation, health information was relatively more important for the preference of a spread compared to environmental information. This suggests that if participants had to choose between one or the other alternative, health labels were superior.

4.4 Limitations

Findings from this study shall not be extrapolated to all populations as the sample of consumers may be representative of the specific geographic regions where the study took place. A substantial part of participants in Copenhagen consisted of expats living in the city, which might have biased comparisons across locations. Results are based on a convenient sample with the aim to identify the effect of additional information on product liking (and not to measure liking for a representative sample of the Danish population). Participating students and the on average high level of education might have influenced the outcome. Lastly, despite the washout period with an additional distraction task between the stages, a carryover effect cannot be completely ruled out. However, the comparison between health and environmental information was unaffected by carryover. The positive attitudes toward the black bean spread could have been confirmed using a home use test in addition to the central location test.

5 Conclusion

The present study investigated the effect of the context of benefits on the liking of pulse-based spreads with different familiarity. The chickpea-based spread was the most
familiar and liked type of spread. The effect of additional information was not affected by familiarity or previous experience but rather by sensory appeal, as found for the chickpea and black bean spreads. Even though the latter was unfamiliar, participants liked the spread more than the fava bean spread. Consequently, a spread based on black beans may provide a promising, acceptable alternative to the common chickpea hummus. Thereby, the familiarity of the chickpea hummus, as it is marketed right now, could be used as a facilitator to introduce rather uncommon products in a “common” form, in the end leading to an adoption of black beans in various forms. Furthermore, the DCE following the tasting session yielded a preference-based profile for new pulse-based spreads considering both intrinsic and extrinsic properties. Additional information on benefits together with sensory appealing products could increase liking and WTP. Whether these benefits were related to health or environmental factors did not play a significant role, and a combination of both used for marketing purposes may be advised.

AUTHOR CONTRIBUTIONS
Katharina Henn: Conceptualization; Methodology; Investigation; Formal analysis; Writing – original draft; Writing – review & editing; Data curation; Visualization.
Helene Christine Reinbach: Methodology; Writing – review – editing; Investigation.
Søren Bøye Olsen: Methodology; Writing – review & editing; Formal analysis.
Margit Dall Aaslyng: Methodology; Investigation; Writing – review & editing.
Susanne Margarete Bølling Laugesen: Methodology; Investigation; Writing – review & editing.
Wender L. P. Bredie: Conceptualization; Supervision; Project administration; Writing – review & editing; Methodology.

ACKNOWLEDGMENTS
This work was financially supported by the European Union Framework Program for Research and Innovation Horizon 2020 under the Marie Skłodowska-Curie Training Network “FOODENGINE” (Grant agreement 765415). The funder played no role in the analysis of the data, interpretation of the results, or writing of the manuscript. The authors acknowledge the help of Sandra Lenz Dethlef sen, Belinda Lange, and Charlotte Dandanell during data collection.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT
The data used for the tables and figures can be accessed at 10.5281/zenodo.7530421.

ETHICS STATEMENT
The study was approved by the joint Research Ethics Committee of the Faculty of Science and Faculty of Health and Medical Sciences at the University of Copenhagen (504-0304/22-5000).

ORCID
Katharina Henn https://orcid.org/0000-0002-9883-5238
Helene Christine Reinbach https://orcid.org/0000-0001-9579-4680
Søren Bøye Olsen https://orcid.org/0000-0002-1278-3749
Margit Dall Aaslyng https://orcid.org/0000-0002-9281-9915
Susanne Margarete Bølling Laugesen https://orcid.org/0000-0003-2523-5108
Wender L. P. Bredie https://orcid.org/0000-0001-5145-4131

REFERENCES


SUPPORTING INFORMATION

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