Food Quality and Preference 143 (2026) 105934

Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

The role of halo effects in consumer perceptions of meat and dairy alternatives

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ARTICLE INFO

Keywords:
Meat and dairy alternatives
Alternative proteins
Consumer perception
Sustainability
Health
Halo effect

ABSTRACT

An increasing number of consumers are reducing their consumption of meat and dairy products and choosing alternatives. Health and environmental concerns are frequently cited as key motivations and selling points. This study investigates whether consumers' willingness to consume meat and dairy alternatives (MDAs), including plant-based, insect-based, and lab-grown products, is associated with perceived healthiness and sustainability. Additionally, it examines whether these perceptions align with objective product characteristics, namely the Nutrient Rich Foods Index (NRF10.3) and CO_2-equivalent values. Beyond rational information processing, consumers rely on mental shortcuts when assessing the healthiness and sustainability of food products. Specifically, the halo effect plays an important role whereby consumers infer additional positive product attributes based on a single perceived strength of a product. Through the lens of the halo effect, this study examines which perceptions are associated with consumers' assessments of different MDAs. A total of 1034 Swiss participants evaluated 15 commercially available MDAs across six dimensions: willingness to consume, perceived enjoyment, healthiness, sustainability, naturalness, and processing. The results show that willingness to consume MDAs is associated with perceived healthiness and, to a lesser extent, with perceived sustainability. However, these perceptions diverge from the NRF10.3 and CO_2-equivalent values. Instead, halo effects seem to influence health and sustainability perceptions. Perceived healthiness is associated with perceived sustainability, naturalness, processing, and enjoyment, while sustainability perceptions are associated with perceived healthiness, naturalness, and enjoyment. Accordingly, health-sustainability, naturalness, and taste halo effects are identified. These findings have important implications for the marketing and communication of MDAs.

1. Introduction

An increasing number of consumers are reducing their consumption of meat and dairy products and choosing alternatives (Hartmann et al., 2022; Kim et al., 2024; Statista, 2024). Health and environment are frequently cited as key motivations (Ammann et al., 2023; Graça et al., 2019; Jahn et al., 2021; Nguyen et al., 2022; Urbanovich & Bevan, 2020; White et al., 2022) and often serve as key selling points for meat and dairy alternatives (MDAs) (Nguyen et al., 2022). However, there is considerable variation in the actual healthiness and environmental impacts of MDAs (Bohrer, 2019; Mehner et al., 2024). To support both personal well-being and broader societal goals, such as healthy and sustainable diets, consumers must accurately assess the healthfulness and sustainability of different MDAs (Apostolidis & McLeay, 2016; Fesenfeld et al., 2023). Research has shown, however, that Swiss consumers often struggle to accurately assess MDAs' healthiness and sustainability (Ammann et al., 2023; Giacone et al., 2024; Hartmann et al., 2022).

This raises the question of what predicts consumers' subjective perceptions of health and sustainability in the context of MDAs. Existing research provides initial insights into potential influencing factors and suggests that these perceptions are not solely predicted by rational arguments or a lack of information (Anders & Schroeter, 2017; Apostolidis & McLeay, 2016; Plasek et al., 2020). Instead, they are shaped by mental shortcuts, among which the halo effect appears particularly influential (Besson et al., 2020; Schuldt et al., 2012). However, there is a lack of empirical studies that systematically examine the predictors of perceived health and sustainability in the context of MDAs. Understanding how mental shortcuts may influence perceptions of the healthiness and sustainability of MDAs is essential for developing

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https://doi.org/10.1016/j.foodqual.2026.105934
Received 27 October 2025; Received in revised form 3 April 2026; Accepted 6 April 2026
Available online 11 April 2026

measures that promote healthy and sustainable eating through MDAs. This is relevant for supporting individual decision-making and for informing effective product marketing and policy design (Anders & Schroeter, 2017; Plasek et al., 2020).

The objective of this study is to address this gap. As a basis, we first examine whether perceived healthiness and sustainability are associated with willingness to consume (WTC) MDAs in our sample and whether the participants can accurately assess the actual health and environmental impacts of these products. Applying the lens of halo effects, we explore which factors predict perceptions of the healthiness and sustainability of MDAs. Specifically, we examine perceived enjoyment (Hansen, 2024) as well as perceived naturalness and processing (Hässig et al., 2023; Meier et al., 2019). We also look at the interplay between perceived healthiness and sustainability, as these perceptions may predict each other through a health-sustainability halo (Lazzarini et al., 2016; Sproesser et al., 2023). Thus, we address the following research questions:

- Are consumers more willing to consume MDAs they perceive as healthy and sustainable (RQ1)?
- Can consumers accurately assess the healthiness and sustainability of MDAs (RQ2)?
- If objective indicators are not the primary predictors, what factors predict perceived healthiness (RQ3)?
- If objective indicators are not the primary predictors, what factors predict perceived sustainability (RQ4)?

2. Exploring consumer perceptions of MDAs

2.1. Willingness to consume MDAs and objective versus subjective health and sustainability

Regarding RQ1, whether consumers are more willing to consume MDAs they perceive as healthy and sustainable, prior research has shown that health and sustainability concerns are key predictors of the willingness to reduce meat consumption and consume alternative products (Ammann et al., 2023; Graça et al., 2019; Nguyen et al., 2022; White et al., 2022). These motives are also frequently used as selling points for MDAs (Nguyen et al., 2022). Therefore, we hypothesize:

- H1a: The healthier consumers perceive MDAs to be, the more willing they are to consume them.
- H1b: The more sustainable consumers perceive MDAs to be, the more willing they are to consume them.

Regarding RQ2, whether consumers can accurately assess the healthiness and sustainability of MDAs, previous research has shown that Swiss consumers' perceptions of the healthiness and sustainability of MDAs do not correlate with objective measures. Specifically, animal-based products are frequently perceived as healthier than plant-based alternatives, potentially due to the higher perceived level of processing associated with MDAs (Giacone et al., 2024; Hartmann et al., 2022). Concerning sustainability, studies indicate that consumers tend to underestimate the negative environmental impact of animal-based products and overestimate that of plant-based alternatives (Giacone et al., 2024; Hartmann et al., 2022). Additionally, there is evidence that consumers generally have limited knowledge of the environmental impact of food products (Camilleri et al., 2019; Jahn et al., 2021; McBey et al., 2019; Nguyen et al., 2022). Therefore, we test the following hypotheses:

- H2a: Consumers' perceptions of the healthiness of MDAs do not correspond to the Nutrient Rich Foods Index (NRF10.3) values of these products.
- H2b: Consumers' perceptions of the sustainability of MDAs do not correspond to the CO_2-equivalents caused by these products.

Previous research comparing Swiss consumers' perceptions of MDAs with objective assessments has focused either on meat alternatives (Hartmann et al., 2022) or dairy alternatives (Giacone et al., 2024), limiting insights into the differences between these product categories. Therefore, this study examines meat and dairy alternatives together.

2.2. What predicts the perceived healthiness and sustainability of MDAs?

The gap between perception and reality cannot be explained solely by a lack of information. Although ample information on the healthiness and sustainability of food products is available, their influence on dietary behavior remains limited (Anders & Schroeter, 2017; Apostolidis & McLeay, 2016; Plasek et al., 2020). If objective indicators do not translate into perceived healthiness and sustainability, what factors predict consumers' perceptions of alternative products (RQs 3 and 4)? Prior research indicates that consumers frequently rely on mental shortcuts when evaluating the health and sustainability attributes of food (Anders & Schroeter, 2017; Hartmann et al., 2022; Lazzarini et al., 2016; Plasek et al., 2020).

One shortcut is the halo effect, especially its health-related variant, the health halo (Besson et al., 2020; Schuldt et al., 2012). The halo effect is a cognitive bias whereby a positive first impression leads to favorable evaluations across unrelated attributes (Asch, 1946; Thorndike, 1920). In the context of food products, this means that consumers infer additional positive qualities, sometimes inaccurately, based on a single perceived strength of a product. In the case of the *health halo* effect, the presence of a single health-related attribute leads consumers to assume that a product also possesses other healthy qualities that are neither explicitly stated nor necessarily true (Besson et al., 2020; Schuldt et al., 2012). For example, products labeled as "gluten-free" are often perceived as healthier, lower in calories, and less processed, despite this not always being the case (Besson et al., 2020). This bias is not limited to nutritional claims; non-nutritional labels, such as "organic" or "fair trade," can also convey a sense of healthiness to consumers (Besson et al., 2020; Schuldt et al., 2012).

2.3. Halo effects in the context of MDAs

Halo effects appear to be relevant for food products in general and for MDAs in particular. Research has suggested that labels such as "plant-based" or "vegetarian" elicit a health halo effect (Besson et al., 2020). For example, consumers rated vegetarian burgers (e.g., Grand Veggie or Veggie Whopper) lower in calories than meat-based burgers, despite objective data showing that the vegetarian burgers contained more calories (Besson et al., 2020).

The health halo effect appears to be particularly pronounced among individuals with favorable attitudes toward plant-based diets. Previous research indicates that individual attitudes and values can moderate the strength of halo effects in both health-related (Schuldt & Schwarz, 2010) and sustainability contexts (Sörqvist et al., 2015). Consequently, favorable attitudes toward MDAs may positively bias evaluations of product attributes, such as healthiness and sustainability, even when objective measures suggest otherwise (Graça et al., 2019).

Perceptions of MDAs may not only be shaped by attitudes toward these products but also by attitudes toward meat. A construct that captures the emotional and cognitive bonds people have with meat is their attachment to it (Graça et al., 2015). Meat attachment reflects the belief that meat is healthy, biologically necessary, and essential for satiety (Nguyen et al., 2022; Reipurth et al., 2019; Tachie et al., 2023). Such positive attitudes toward meat may generate halo effects that influence perceptions of the healthiness and sustainability of meat. For example, Swiss consumers with strong meat attachment often view meat as a vital component of a balanced diet and are less likely to acknowledge its negative environmental impacts (Götze & Brunner, 2021; Hagmann et al., 2019).

Meat attachment may also contribute to the devaluation of MDAs.

Such a *reverse halo effect* is conceptually consistent with findings by Schuldt et al. (2012), who showed that negative information about a company's practices can diminish the perceived healthiness of its products. In the context of MDAs, existing research suggests that consumers with high meat attachment tend to perceive MDAs as less tasty, less nutritious, and less essential for a balanced diet while also discounting their sustainability benefits (Götze & Brunner, 2021; Graça et al., 2019; Hoek et al., 2011; Kim et al., 2024). Although the reverse halo effect remains hypothetical, it provides a useful lens for understanding how strong meat attachment may not only enhance perceptions of meat but may also negatively influence perceptions of MDAs.

Additional halo-effects may influence perceptions of the healthiness and sustainability of MDAs, namely perceived healthiness and sustainability, respectively (health-sustainability halo), naturalness (naturalness halo), and taste (taste halo; e.g., Hansen, 2024; Hartmann et al., 2022; Meier et al., 2019; Raghunathan et al., 2006).

2.4. Health–sustainability halo

A strong association has been observed between perceived healthiness and the perceived sustainability of food products. Hartmann et al. (2022) found that Swiss consumers perceive meat- and plant-based products that they consider healthy to be more sustainable. This pattern can be described as a *health–sustainability halo*, whereby consumers infer additional, potentially unrelated positive attributes, such as sustainability, from an initial positive perception, such as healthiness, and vice versa (Hartmann et al., 2022; Lazzarini et al., 2016). This association persists even when the two attributes are objectively unrelated or inaccurately assessed. Although environmentally friendly products are not necessarily nutritious, and healthy products are not necessarily environmentally sustainable, Swiss consumers tend to perceive a substantial overlap between the two attributes (Hartmann et al., 2022). Recent studies have substantiated this pattern, describing it as a "healthy = sustainable" heuristic (Eichin et al., 2025; Sproesser et al., 2023). In meal contexts, individuals who perceive a meal as healthier also tend to rate it as more sustainable, even when objective indicators of nutritional quality and environmental impact diverge (Sproesser et al., 2023). Experimental evidence further shows that this relationship operates bidirectionally: perceiving a product as healthy increases its perceived sustainability, while perceiving it as sustainable increases its perceived healthiness (Eichin et al., 2025). Based on the health–sustainability halo effect, we hypothesize:

- H3a: The more sustainable consumers perceive an MDA to be, the healthier they perceive it to be.
- H4a: The healthier consumers perceive an MDA to be, the more sustainable they perceive it to be.

2.5. Naturalness halo

Another factor associated with healthiness and sustainability perceptions is a product's perceived naturalness. This perception is also subject to a halo effect. Products perceived as "natural" are often assessed as healthier and tastier, a phenomenon commonly referred to as the "natural-is-better" belief (Hartmann et al., 2022; Meier et al., 2019; Román et al., 2017). The strong association between perceived naturalness, healthiness, and environmental friendliness may contrast with objective assessments. For example, natural ingredients in food can be toxic (Román et al., 2017). One explanation for this discrepancy is that perceptions of naturalness are closely linked to perceived food processing. The more processed Swiss consumers perceived a food to be, the less healthy they rated it (Hässig et al., 2023). Many MDAs are industrially processed, and although novel food technologies can offer safe, nutritious, and more sustainable options, they may reduce a product's perceived naturalness.

The naturalness halo effect can subsequently shape perceptions of healthiness and sustainability (Hartmann et al., 2022; Sadler et al., 2021; Siegrist & Sütterlin, 2017). This highlights the critical role of processing perceptions: Consumers may evaluate objectively healthier or more sustainable MDAs negatively if they perceive them as highly processed and therefore unnatural. Therefore, we hypothesize the following for *perceived healthiness*:

- H3b: The more natural consumers perceive an MDA to be, the healthier they perceive it to be.
- H3c: The more processed consumers perceive an MDA to be, the less healthy they perceive it to be.

Like healthiness, consumers tend to perceive more natural products as more sustainable (Hartmann et al., 2022; Román et al., 2017). Here, too, perceived processing plays a central role. Swiss consumers often lack precise knowledge about the actual environmental impacts of different food production methods, and therefore tend to view processed foods as less environmentally friendly than unprocessed foods (Hartmann et al., 2021; Lazzarini et al., 2016, 2017). Therefore, we hypothesize the following for *perceived sustainability*:

- H4b: The more natural consumers perceive an MDA to be, the more sustainable they perceive it to be.
- H4c: The more processed consumers perceive an MDA to be, the less sustainable they perceive it to be.

2.6. Taste halo

While enjoyment is a well-established driver of food consumption, there is evidence that the experience of enjoyment itself shapes perceived healthiness (Plasek et al., 2020). Although the "unhealthy = tasty" belief suggests that consumers expect healthier foods to be less enjoyable (Raghunathan et al., 2006), recent research has proposed a competing mechanism. Hansen (2024) showed that experienced enjoyment can positively influence perceived dietary quality, that is, how healthy a product is perceived to be, particularly among individuals with low motivation to eat healthily (Hansen, 2024). In such contexts, consumers may base their overall evaluation of a product (e.g., "Is this a good product?") on their affective response (e.g., "How do I feel about it?"; Hansen, 2024). Consequently, these findings challenge the "unhealthy = tasty" belief and instead suggest a taste halo effect whereby a positively evaluated attribute, such as good taste or enjoyment, spills over to another unrelated attribute, namely healthiness.

This mechanism aligns with the concept of *motivated reasoning*, whereby individuals justify their preferences by adjusting their beliefs; for example, "I enjoy eating this food, so it must be healthy" (Kunda, 1990). Based on the taste halo effect, we hypothesize the following:

- H3d: The more consumers enjoy an MDA, the healthier they perceive it to be.

There is less evidence of an association between taste or enjoyment and perceived sustainability. However, drawing on motivated reasoning, we expect a similar relationship:

- H4d: The more consumers enjoy an MDA, the more sustainable they perceive it to be.

3. Overview of research questions and hypotheses

In summary, this study addresses the following research questions and tests the hypotheses listed in Table 1.

Table 1
Overview of the research questions and hypotheses.

Research Questions	Hypotheses
RQ1: Are consumers more willing to consume MDAs they perceive as healthy and sustainable?	• H1a: The healthier consumers perceive MDAs to be, the more willing they are to consume them. • H1b: The more sustainable consumers perceive MDAs to be, the more willing they are to consume them.
RQ2: Can consumers accurately assess the healthiness and sustainability of MDAs?	• H2a: Consumers' perceptions of the healthiness of MDAs do not correspond to the NRF10.3 values of these products. • H2b: Consumers' perceptions of the sustainability of MDAs do not correspond to the CO_2-equivalents caused by these products.
RQ3: If objective indicators are not the primary predictors, what factors predict perceived healthiness?	Health–sustainability halo • H3a: The more sustainable consumers perceive an MDA to be, the healthier they perceive it to be. Naturalness halo • H3b: The more natural consumers perceive an MDA to be, the healthier they perceive it to be. • H3c: The more processed consumers perceive an MDA to be, the less healthy they perceive it to be. Taste halo • H3d: The more consumers enjoy an MDA, the healthier they perceive it to be.
RQ4: If objective indicators are not the primary predictors, what factors predict perceived sustainability?	Health–sustainability halo • H4a: The healthier consumers perceive an MDA to be, the more sustainable they perceive it to be. Naturalness halo • H4b: The more natural consumers perceive an MDA to be, the more sustainable they perceive it to be. • H4c: The more processed consumers perceive an MDA to be, the less sustainable they perceive it to be. Taste halo • H4d: The more consumers enjoy an MDA, the more sustainable they perceive it to be.

4. Methods

4.1. Participants

An online survey was conducted over two weeks in early December 2023. Participants were recruited via a national market research panel and compensated by the panel provider. The study received ethical approval from the Ethics Committee of the University of Bern, Faculty of Business, Economics and Social Sciences. All participants provided informed consent before participation and met the 18-year minimum age requirement.

To ensure that the sample was broadly representative of the Swiss population, quotas were applied based on age group, gender, and language region (German-speaking vs. French-speaking). A Swiss sample was chosen because the Swiss market for MDAs has expanded rapidly in recent years, including strong growth in sales of MDAs and the number of available MDAs (Federal Office for Agriculture, 2022; Herrmann & Bolliger, 2021).

A total of 1088 participants completed the survey. Based on the exclusion criteria in similar research (Giacone et al., 2024; Hartmann et al., 2022; Hässig et al., 2023), we excluded 54 individuals because they completed the survey in less than half of the median response time. Therefore, the final sample consisted of 1034 participants (50.8% women, 49.2% men; 74.2% German-speaking, 25.8% French-speaking). The ages ranged from 18 to 74 years ($M = 45.9$, $SD = 15.1$). Educational levels were categorized as low (48.4%; no degree, compulsory schooling, vocational training) or high (51.6%; high school diploma, college/university degree). Most participants lived in urban areas (60.3%), followed by suburban areas (23.4%) and rural areas (16.3%).

This study was preregistered on the Open Science Framework (OSF). All materials, including the anonymized dataset and the R analysis script, are publicly accessible via OSF and contain no identifying information (https://osf.io/wuqkd).

4.2. Material and procedure

The online questionnaire presented participants with 15 MDAs: plant-based burger, falafel, plant-based chicken chunks, cheese alternative, plant-based cold cuts, insect balls, soy yogurt, lab-grown meat, oat drink, Quorn, soy cream, plant-based schnitzel, minced seitan, tofu, and plant-based sausage. To ensure a comprehensive selection, products were chosen based on two criteria: production type (autotrophic vs. heterotrophic) and degree of processing.

Autotrophic products originate from plant-based or microbial production (e.g., plant-based burger, tofu, oat drink), whereas heterotrophic products originate from animal-based or organically fed microbial processes (e.g., insect balls, lab-grown meat, Quorn; see also Mehner et al., 2024). The degree of processing was determined by the highest processing technology used for each product and classified into four levels: simple physical processes, advanced physical processes, biochemical processes, and complex biotechnological processes.

The selected products covered all processing categories except simple physical processing, as minimally processed foods are not typically marketed as meat or dairy alternatives. Combining production type and

Table 2
Classification of alternative products by type of production and technology used in processing.

Main Category	Meat Alternatives	Dairy Alternatives
Autotrophic-physical	Plant-based burger, falafel, plant-based schnitzel, plant-based sausage, plant-based chicken chunks, plant-based cold cuts, minced seitan	Oat drink, soy yogurt, soy cream, cheese alternative
Autotrophic-biochemical	Tofu	
Heterotrophic-physical	Insect balls, Quorn	
Heterotrophic-biotechnological	Lab-grown meat	

processing level, products were grouped into four categories: autotrophic-physical, autotrophic-biochemical, heterotrophic-physical, and heterotrophic-biotechnological (see Table 2). The heterotrophic-biochemical and autotrophic-biotechnological categories were excluded because no market-available products met these criteria.

All products were available in the Swiss retail market in 2023, except for lab-grown meat. To minimize biases, health-related (e.g., high protein, Nutri-Score) and sustainability-related (e.g., organic, climate footprint) labels were removed from all product images.

Participants' evaluation of the products was structured into six sequential blocks, one for each dimension. The order of the blocks was fixed across the participants. Participants first rated all 15 products on (1) WTC before proceeding to the next block to rate all products on (2) enjoyment, followed by (3) health, (4) environmental sustainability, (5) naturalness, and (6) processing. Within each block, the 15 products were presented in randomized order to minimize order effects. Ratings were made using a sliding scale ranging from 0 (e.g., not healthy) to 100 (e.g., healthy), with the slider's starting position set at 50 (see Fig. 1). Consistent with similar studies (Giacone et al., 2024; Hartmann et al., 2022; Hässig et al., 2023; Lazzarini et al., 2016), the terms of the rating dimensions (e.g., health or environmental sustainability) were not further specified so that participants could openly interpret their meaning.

Additionally, the questionnaire included questions about the participants' behaviors and attitudes. Diet was coded as a binary variable, with participants without specific dietary restrictions serving as the reference group (n = 731) and those following specific diets (e.g., vegetarian or vegan) as the comparison group (n = 303). The questionnaire also assessed experience with meat or dairy alternatives. Participants with no experience were coded as 1 (meat = 23.1%, dairy = 47.7%), those with rare experience as 2 (meat = 32.1%, dairy = 24.3%), and those with regular experience as 3 (meat = 44.8%, dairy = 28.0%). Attitude toward MDAs was measured using a six-item Likert scale ranging from very negative to very positive. Furthermore, meat attachment was assessed using a 15-item meat attachment scale (Graça et al., 2015; Kühn et al., 2023; Cronbach's alpha = 0.93). Item responses were averaged to compute a mean score for each participant, ranging from 1 to 5 (M = 3.39, SD = 0.88).

Participants also provided demographic information, including gender, age, education, and urbanity. Gender was coded as a binary variable, with female participants as the reference group. Education was coded as a binary variable, with low education as the reference group. Urbanity was coded into the three categories rural, suburban, and urban, with rural as the reference group.

To compare the participants' healthiness perceptions with the objective health impact of the alternative products, the NRF10.3 index was used. This index quantifies nutritional quality per 100 g by considering 10 qualifying and 3 disqualifying nutrients. Following the methodology of Mehner et al. (2024), the qualifying nutrients include fiber, protein, calcium, iron, potassium, magnesium, iodine, and vitamins A, C, and E. The disqualifying nutrients are based on Fulgoni et al. (2009) and include added sugars, sodium, and saturated fats. The NRF10.3 value for each product was calculated by subtracting the disqualifying nutrient scores from the qualifying nutrient scores, yielding an overall measure of nutrient density. Higher values indicate better nutritional quality (see Appendix A, Table A.1 for detailed NRF10.3 values by product).

Furthermore, a sustainability score was calculated to compare the participants' sustainability ratings with the objective sustainability of the alternative products. Objective sustainability was operationalized using global warming potential (kg CO_2eq), which represents the total greenhouse gases emitted during a product's production and life cycle. Lower kg CO_2eq values indicate a smaller impact on climate change. This measure was selected because it is widely used in food product assessments (Mehner et al., 2024; Poore & Nemecek, 2018). The kg CO_2eq values used were calculated specifically for the Swiss context (see Appendix A, Table A.2 for detailed values by product).

4.3. Statistical analysis

The data analysis included descriptive statistics and visualizations to check for outliers, missing data, and distribution patterns. All analyses were performed using R. Relationships between predictor variables and outcomes were examined using mixed-effects regression models, which accounted for repeated measures by including random intercepts for participants and products. Preliminary analyses indicated non-normality due to extreme values at the scale points 0, 50, and 100 (see Appendix B).

To address these violations, the continuous dependent variables, including WTC (RQ1), perceived health (RQ3), and perceived sustainability (RQ4), were recoded into three ordinal categories (low: ≥0 to <33; medium: ≥33 to <66; high: ≥66 to ≤100; see Appendix B). This

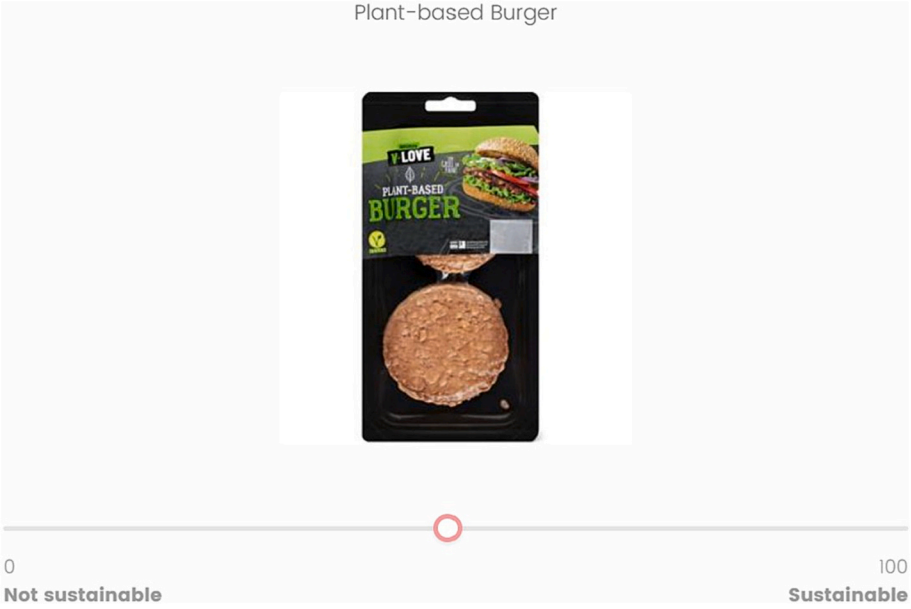

Fig. 1. Example of the rating scale used to assess perceived sustainability.

enabled the use of ordinal logistic regression in the form of cumulative link mixed models (CLMMs), which can handle ordinal data and allow for random effects (Christensen, 2018). This approach solved the problem of extreme values and provided more robust statistical inferences regarding the relationships between predictors and outcomes. Although linear mixed-effects models were preregistered, CLMMs were deemed more appropriate given the observed data structure and distribution. Full details and robustness checks using the preregistered linear mixed-effects models are reported in the Supplementary Material (Chapter 3).

For RQs 1, 3, and 4, CLMMs were estimated. Each model included random intercepts for participants and products to account for repeated measures. To examine the differences between meat and dairy alternatives, a dummy variable was included (meat alternatives = 0; dairy alternatives = 1). All models further included the covariates of experience with meat alternatives, experience with dairy alternatives, attitude toward MDAs, meat attachment, gender, age, education, and urbanity. For RQ3, an interaction term between diet and meat attachment was also included. Continuous variables were standardized to ensure consistency in scale across predictors. To provide an overview of the different predictors, we compiled them in Table 3.

Multicollinearity among predictors was assessed using variance inflation factors (VIFs) to ensure stable parameter estimation. To account for the multiple testing of several predictors across the three distinct models, *p*-values were adjusted using the Bonferroni-Holm procedure. This method was applied to the pooled set of all model coefficients to stringently control the family-wise error rate. Results were considered statistically significant when the adjusted p-values were < 0.05. Detailed model comparisons and VIFs are reported in the Supplementary Material (Chapter 1).

Research Question 2, participants' ability to accurately assess the healthiness and sustainability of MDAs, was examined using Spearman's rank correlations. For each participant, correlations were calculated between the perceived healthiness/sustainability and the objective nutrient density or global warming potential of the 15 products. Because correlations cannot be computed when ratings show no variation across products, participants who showed invariant health assessments ($n = 43$) were excluded from the health correlation analysis, and those with invariant sustainability assessments ($n = 57$) were excluded from the sustainability correlation analysis. Overall correlations were then derived by applying Fisher's Z transformation to individual correlation coefficients and calculating the mean of the transformed values. In addition to the correlational analyses, descriptive comparisons of raw product-level means were conducted to explore the alignment between the perceived and objective values for each product.

Because lab-grown meat was not available on the Swiss market in 2023 and Swiss consumers have limited familiarity with insects as food, all analyses were rerun excluding these products as a robustness check. Excluding these products did not change the direction or statistical significance of the main findings (see Supplementary Material, Chapter 2).

5. Results

5.1. Perceived healthiness and sustainability predict willingness to consume (RQ1)

To examine whether consumers are more willing to consume MDAs they perceive as healthy and sustainable, a CLMM was estimated with WTC (low, medium, high) as the ordinal outcome. Perceived healthiness and sustainability were included as the main predictors. The model further controlled for experience with meat alternatives, experience with dairy alternatives, attitude toward MDAs, meat attachment, age, gender, education, urbanity, and meat vs. dairy alternative. Random intercepts were specified for the participants and for the products.

The results indicated that perceived healthiness and sustainability

Table 3
Overview of the predictors for research questions 1, 3, and 4.

Predictor	Definition	Type	Scale	Coding
Health	Perceived healthiness of a product from unhealthy (0) to healthy (100)	Continuous	Standardized	Originally 0–100
Sustainability	Perceived environmental sustainability of a product from not sustainable (0) to sustainable (100)	Continuous	Standardized	Originally 0–100
Enjoyment	Perceived enjoyment of a product from not enjoy (0) to enjoy (100)	Continuous	Standardized	Originally 0–100
Naturalness	Perceived naturalness of a product from not natural (0) to natural (100)	Continuous	Standardized	Originally 0–100
Processing	Perceived processing of a product from not processed (0) to highly processed (100)	Continuous	Standardized	Originally 0–100
Meat attachment	15-item meat attachment scale	Continuous	Standardized	Mean score of the 15 items (originally 1–5)
Diet	How would you describe your current diet?	Binary	Dummy	0 = no dietary restrictions 1 = following a specific diet
Attitude	How would you describe your attitude toward meat and dairy alternatives?	Continuous	Standardized	Originally from 1 = very negative to 6 = very positive
Experience meat alternatives	How often do you eat meat alternatives?	Ordinal	3 levels	1 = never 2 = rarely 3 = regularly
Experience dairy alternatives	How often do you eat dairy alternatives?	Ordinal	3 levels	1 = never 2 = rarely 3 = regularly
Age	How old are you?	Continuous	Standardized	Originally 18–74
Gender	What is your gender?	Binary	Dummy	1 = female 2 = male
Education	What is your highest level of education?	Binary	Dummy	0 = no degree, compulsory schooling, vocational training 1 = high school diploma, college/ university degree
Urbanity	What is the postal code of your place of residence?	Ordinal	3 levels	1 = rural 2 = suburban 3 = urban
Meat or dairy alternative	Is the assessed product a meat or a dairy alternative?	Binary	Dummy	0 = meat alternative 1 = dairy alternative

Table 4
Results of the CLMM predicting WTC from perceived health, perceived sustainability, meat attachment, attitude, experience with meat alternatives, experience with dairy alternatives, age, gender, education, urbanity, and meat or dairy alternative.

Predictors	Odds Ratios	Standard Error	95% CI	p	Bonferroni-Holm p
Fixed Effects					
health	3.46	0.12	3.23–3.70	**<0.001**	**<0.001**
sustainability	1.54	0.05	1.44–1.65	**<0.001**	**<0.001**
meat attachment	0.82	0.05	0.73–0.92	**0.001**	**0.018**
attitude	1.37	0.09	1.21–1.56	**<0.001**	**<0.001**
experience meat alternatives	1.77	0.12	1.54–2.03	**<0.001**	**<0.001**
experience dairy alternatives	1.24	0.07	1.10–1.39	**<0.001**	**0.007**
age	0.83	0.04	0.75–0.92	**<0.001**	**0.006**
gender (male)	1.27	0.12	1.05–1.54	**0.015**	0.340
education (high)	1.08	0.11	0.89–1.31	0.461	1.000
urbanity (suburban)	1.02	0.16	0.75–1.38	0.911	1.000
urbanity (urban)	1.40	0.19	1.08–1.82	**0.012**	0.310
meat or dairy alternative (dairy)	0.48	0.11	0.30–0.76	**0.002**	**0.045**
Thresholds					
low|medium	9.20	2.33	5.59–15.12	**<0.001**	**<0.001**
medium|high	46.33	11.84	28.08–76.44	**<0.001**	**<0.001**
Random Effects					
σ^2	3.29				
$\tau_{00\ ResponseId}$	1.73				
$\tau_{00\ Product}$	0.16				
ICC	0.36				
$N_{ResponseId}$	1029				
$N_{Product}$	15				
Observations	15,435				
Marginal R^2 / Conditional R^2	0.467 / 0.661				

Note. Fixed effects describe the impact of predictors on the odds of higher WTC. Thresholds represent the estimated cut-points on a latent scale that separate the three ordinal categories of WTC. Random effects represent intercept variance at the participant and product levels. For a detailed description of all fixed-effects predictors, see Table 3.

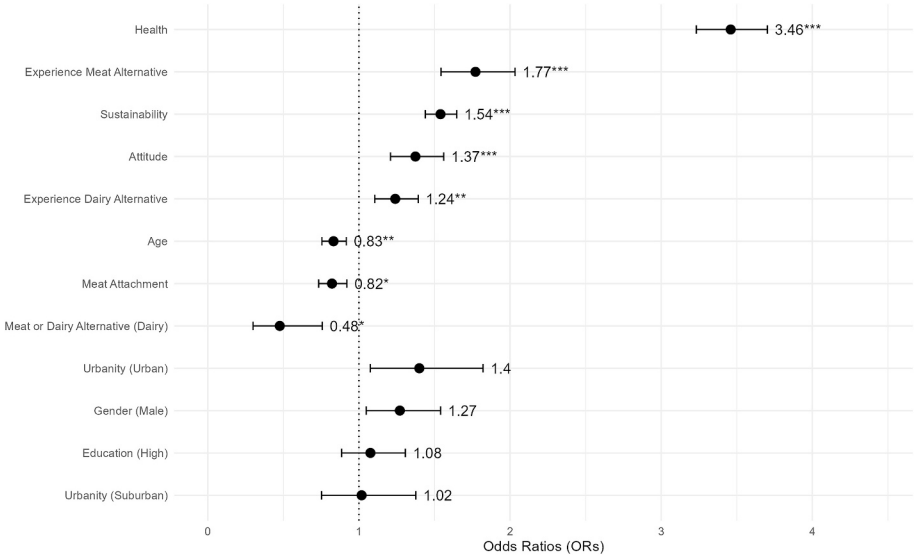

Fig. 2. Odds ratios and 95% confidence intervals for predictors of willingness to consume alternative products.

were associated with WTC across the 15 alternative products, with perceived healthiness showing the strongest association. Higher perceived healthiness was associated with greater WTC (*OR* = 3.46, *95% CI* [3.23–3.70]), while perceived sustainability was also positively related to WTC, albeit to a lesser extent (*OR* = 1.54, *95% CI* [1.44–1.65]). More experience with meat (*OR* = 1.77, *95% CI* [1.54–2.03]) and dairy alternatives (*OR* = 1.24, *95% CI* [1.10–1.39]) further increased WTC, as did a more positive attitude toward MDAs (*OR* = 1.37, *95% CI* [1.21–1.56]). In contrast, higher age (*OR* = 0.83, *95% CI* [0.75–0.92]) and stronger meat attachment (*OR* = 0.82, *95% CI* [0.73–0.92]) were associated with a lower WTC. It initially appeared that men showed higher odds of being in a higher WTC category than women (*OR* = 1.27, *95% CI* [1.05–1.54]); however, this association was no longer statistically significant after applying the Bonferroni-Holm adjustment. Participants showed lower WTC dairy than meat alternatives (*OR* = 0.48, *95% CI* [0.30–0.76]; see Table 4 and Fig. 2). VIFs indicated no evidence of problematic multicollinearity (all VIFs <5).

Overall, the model indicates that higher perceived healthiness, perceived sustainability, experience with MDAs, and a more positive attitude toward MDAs are associated with greater WTC the 15 alternative products, while higher age and stronger meat attachment are associated with lower WTC. The model explains 66.1% of the total

variance in WTC, accounting for both fixed and random effects (conditional $R^2 = 0.661$). The intraclass correlation coefficient (ICC) shows that 36% of the variance is attributable to differences at the participant and product levels.

5.2. Consumers struggle to accurately assess healthiness and sustainability (RQ2)

The accuracy of consumers' assessments of MDAs was examined by analyzing the relationship between perceived healthiness and objective nutritional density, and between perceived sustainability and global warming potential. For healthiness, the results revealed a weak negative correlation ($r_z = -0.13$, *95% CI* [−0.15, −0.11]), indicating that products with a higher nutritional density were perceived as less healthy. Sustainability ratings were also weakly negatively correlated with global warming potential ($r_z = -0.14$, *95% CI* [−0.16, −0.12]), suggesting that products with a higher environmental impact tended to be perceived as less sustainable. The correlations indicate that consumer ratings did not align with the objective health measure and were only weakly aligned with the objective sustainability measure.

Descriptive product-level analyses revealed considerable variation between perceived healthiness and sustainability ratings and their corresponding objective indicators (Figs. 3 and 4). For example, ratings of the cheese alternative showed a relatively close alignment between perceived healthiness and nutrient density as well as between perceived sustainability and global warming potential. In contrast, plant-based sausages received lower consumer ratings on both dimensions despite more favorable objective profiles.

5.3. Perceptions of naturalness, sustainability, enjoyment, and processing predict healthiness perceptions (RQ3)

To examine the factors that shape perceived healthiness, a CLMM was estimated with the perceived healthiness of alternative products (low, medium, high) as the ordinal outcome. Perceived naturalness, sustainability, enjoyment, and degree of processing were included as the main predictors. The model further controlled for experience with meat alternatives, experience with dairy alternatives, attitude toward MDAs, age, gender, education, urbanity, and meat vs. dairy alternative. An interaction term between diet and meat attachment was included, and random intercepts were specified for the participants and products.

The results indicated that perceptions of naturalness, sustainability, enjoyment, and degree of processing predicted perceived healthiness. Higher perceived naturalness (*OR* = 2.88, *95% CI* [2.68–3.08]), sustainability (*OR* = 2.59, *95% CI* [2.41–2.78]), and anticipated enjoyment (*OR* = 2.41, *95% CI* [2.27–2.56]) increased the odds that a product was perceived as healthier. In contrast, products perceived as highly processed were less likely to be seen as healthy (*OR* = 0.81, *95% CI* [0.77–0.86]).

A more positive attitude toward MDAs was associated with a higher perceived healthiness of alternative products (*OR* = 1.50, *95% CI* [1.30–1.74]). There initially appeared to be an interaction between diet and meat attachment (*OR* = 1.34, *95% CI* [1.05–1.72]); however, the interaction was no longer statistically significant after applying the Bonferroni-Holm adjustment. Additionally, it initially appeared that dairy alternatives were perceived as healthier than meat alternatives (*OR* = 1.34, *95% CI* [1.05–1.72]); however, this association was no longer statistically significant after applying the Bonferroni-Holm adjustment (see Table 5 and Fig. 5).

The model explained 74.0% of the variance in the perceived healthiness of alternative products (conditional $R^2 = 0.740$). Notably, 42% of the variance was attributable to differences at the participant and product levels (ICC = 0.42).

5.4. Perceptions of healthiness, naturalness, and enjoyment predict sustainability perceptions (RQ4)

To examine the factors that shape perceived sustainability, a CLMM was estimated, with perceived sustainability (low, medium, high) as the ordinal outcome. Predictors included perceived enjoyment, healthiness, naturalness, processing, experience with meat alternatives, experience with dairy alternatives, meat attachment, attitude, age, gender, education, urbanity, and meat vs. dairy alternative. Random intercepts for participants and products were included.

Perceived sustainability was associated with perceived healthiness, naturalness, enjoyment, and attitudes toward MDAs. Higher perceived healthiness (*OR* = 2.59; *95% CI* [2.41–2.78]), naturalness (*OR* = 2.44; *95% CI* [2.27–2.62]), perceived enjoyment (*OR* = 1.30; *95% CI* [1.22–1.38]), and more positive attitudes toward MDAs (*OR* = 1.83; *95% CI* [1.53–2.20]) were associated with higher perceived sustainability. In contrast to healthiness, the perceived degree of processing was not associated with sustainability perceptions. Although education initially appeared to be associated with perceived sustainability (*OR* = 1.42, *95% CI* [1.07–1.88]), this association was no longer significant

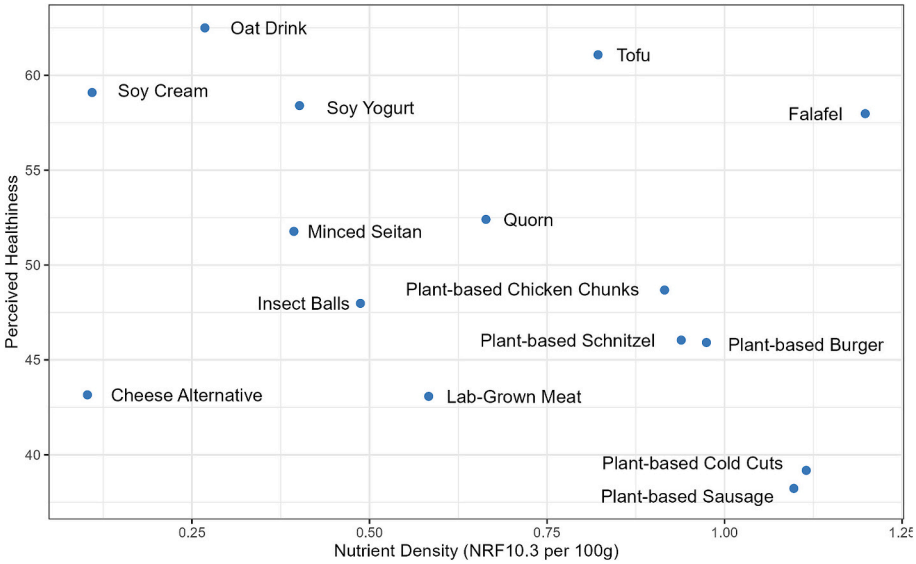

Fig. 3. Relationship between perceived healthiness and nutrient density (NRF10.3) of alternative products. Points show mean product ratings.

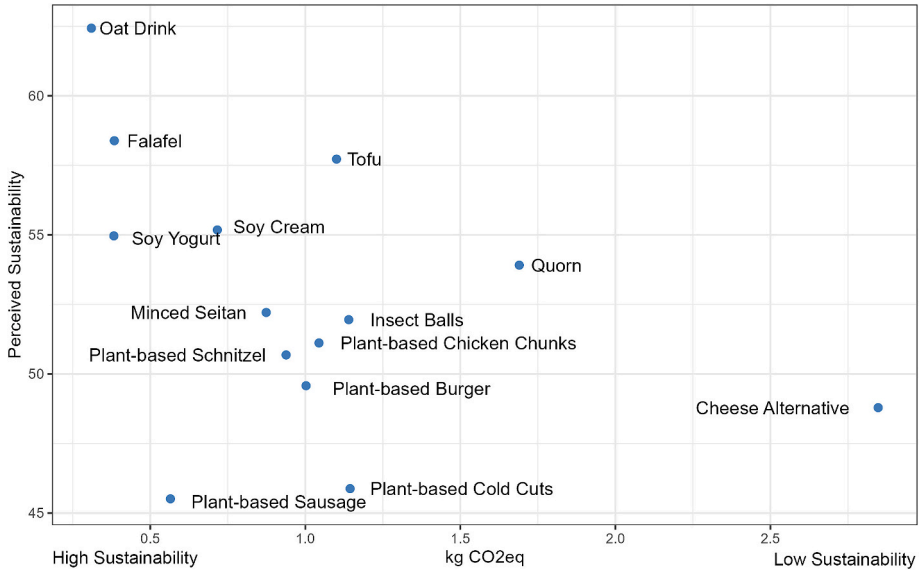

Fig. 4. Relationship between perceived sustainability and CO_2eq (kg CO_2eq) of alternative products. Points show mean product ratings. Lab-grown meat was excluded from the plot due to its exceptionally high CO_2eq value (14.24 kg CO_2eq, mean perceived sustainability = 45.4).

Table 5
Results of the CLMM predicting perceived healthiness of alternative products from perceived sustainability, enjoyment, naturalness, degree of processing, attitude, experience with meat alternatives, experience with dairy alternatives, age, gender, education, urbanity, meat or dairy alternative, and an interaction between meat attachment and diet.

Predictors	Odds Ratios	Standard Error	95% CI	p	Bonferroni-Holm p
Fixed Effects					
sustainability	2.59	0.09	2.41–2.78	**<0.001**	**<0.001**
enjoyment	2.41	0.07	2.27–2.56	**<0.001**	**<0.001**
naturalness	2.88	0.10	2.68–3.08	**<0.001**	**<0.001**
processing	0.81	0.02	0.77–0.86	**<0.001**	**<0.001**
meat attachment	1.03	0.09	0.86–1.23	0.785	1.000
diet (restrictions)	1.10	0.16	0.83–1.47	0.489	1.000
attitude	1.50	0.11	1.30–1.74	**<0.001**	**<0.001**
experience meat alternatives	1.09	0.08	0.93–1.27	0.293	1.000
experience dairy alternatives	0.95	0.06	0.84–1.09	0.496	1.000
age	1.09	0.06	0.98–1.21	0.128	1.000
gender (male)	0.96	0.10	0.77–1.19	0.705	1.000
education (high)	0.86	0.09	0.69–1.07	0.167	1.000
urbanity (suburban)	1.20	0.20	0.86–1.67	0.276	1.000
urbanity (urban)	1.12	0.16	0.84–1.50	0.438	1.000
meat or dairy alternative (dairy)	1.47	0.23	1.07–2.00	**0.016**	0.344
meat attachment × diet	1.34	0.17	1.05–1.72	**0.018**	0.386
Thresholds					
low|medium	0.20	0.05	0.12–0.33	**<0.001**	**<0.001**
medium|high	6.04	1.56	3.64–10.03	**<0.001**	**<0.001**
Random Effects					
σ^2	3.29				
$\tau_{00\ ResponseId}$	2.28				
$\tau_{00\ Product}$	0.07				
ICC	0.42				
$N_{ResponseId}$	1029				
$N_{Product}$	15				
Observations	15,435				
Marginal R^2 / Conditional R^2	0.554 / 0.740				

Note. Fixed effects describe the impact of predictors on the odds of higher healthiness perceptions. Thresholds represent the estimated cut-points on a latent scale that separate the three ordinal categories of healthiness perceptions. Random effects represent intercept variance at the participant and product levels. For a detailed description of all fixed-effects predictors, see Table 3.

after the Bonferroni-Holm adjustment. No differences in sustainability perceptions were observed between meat and dairy alternatives (see Table 6 and Fig. 6).

The model explained 73.6% of the total variance (conditional R^2 = 0.736). 55% of the total model variation is attributable to differences at the participant and product levels (ICC = 0.55).

6. Discussion

In line with key consumption motives and selling points for MDAs, this study shows that consumers' WTC these products is associated with perceived healthiness and, to a lesser extent, with perceived sustainability (RQ1). This finding confirms previous research that consumers

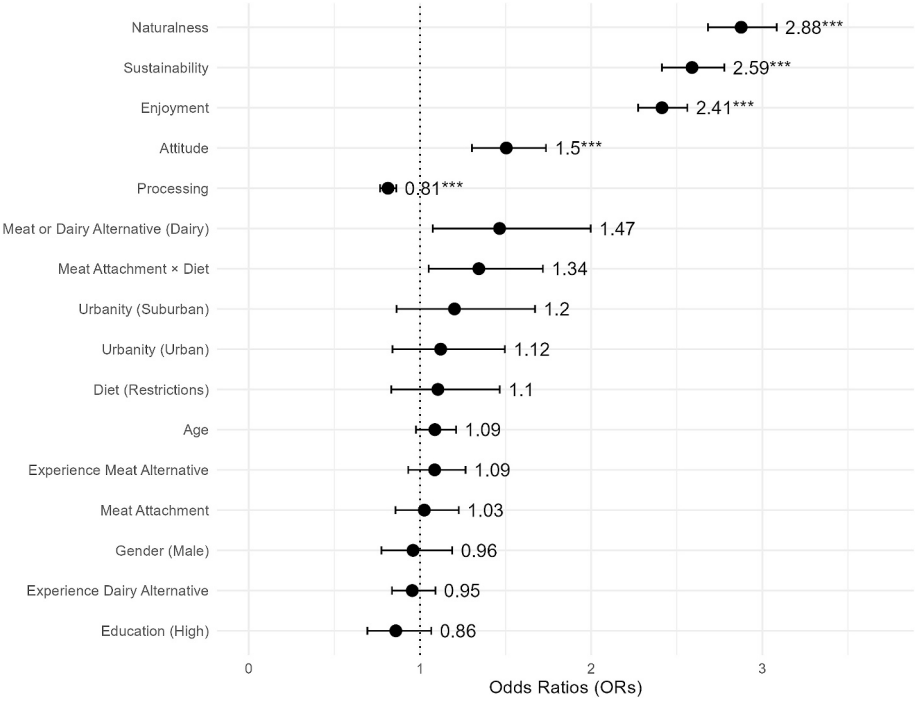

Fig. 5. Odds ratios and 95% confidence intervals for predictors of perceived healthiness of alternative products.

Table 6
Results of the CLMM predicting perceived sustainability of alternative products from perceived healthiness, enjoyment, naturalness, degree of processing, meat attachment, attitude, experience with meat alternatives, experience with dairy alternatives, age, gender, education, urbanity, and meat or dairy alternative.

Predictors	Odds Ratios	Standard Error	95% CI	p	Bonferroni-Holm p
Fixed Effects					
health	2.59	0.10	2.41–2.78	**<0.001**	**<0.001**
enjoyment	1.30	0.04	1.22–1.38	**<0.001**	**<0.001**
naturalness	2.44	0.09	2.27–2.62	**<0.001**	**<0.001**
processing	1.03	0.03	0.97–1.09	0.311	1.000
meat attachment	0.91	0.08	0.77–1.07	0.269	1.000
attitude	1.83	0.17	1.53–2.20	**<0.001**	**<0.001**
experience meat alternatives	1.05	0.11	0.86–1.28	0.643	1.000
experience dairy alternatives	0.99	0.09	0.84–1.18	0.951	1.000
age	1.05	0.07	0.91–1.21	0.500	1.000
gender (male)	1.13	0.16	0.85–1.49	0.397	1.000
education (high)	1.42	0.20	1.07–1.88	**0.014**	0.330
urbanity (suburban)	1.01	0.22	0.66–1.55	0.961	1.000
urbanity (urban)	1.05	0.20	0.72–1.52	0.798	1.000
meat or dairy alternative (dairy)	0.97	0.09	0.80–1.17	0.713	1.000
Thresholds					
low|medium	0.19	0.06	0.10–0.36	**<0.001**	**<0.001**
medium|high	6.01	1.92	3.22–11.25	**<0.001**	**<0.001**
Random Effects					
σ^2	3.29				
$\tau_{00\ ResponseId}$	4.07				
$\tau_{00\ Product}$	0.02				
ICC	0.55				
$N_{ResponseId}$	1029				
$N_{Product}$	15				
Observations	15,435				
Marginal R^2 / Conditional R^2	0.408 / 0.736				

Note. Fixed effects describe the impact of predictors on the odds of higher sustainability perceptions. Thresholds represent the estimated cut-points on a latent scale that separate the three ordinal categories of sustainability perceptions. Random effects represent intercept variance at the participant and product levels. For a detailed description of all fixed-effects predictors, see Table 3.

tend to prioritize attributes with immediate personal relevance, such as health, over collective or long-term concerns, such as environmental sustainability (Ammann et al., 2024; Piracci et al., 2023; Rehman et al., 2024; van Bussel et al., 2022). Consistent with prior studies, age and meat attachment were negatively associated with WTC, whereas experience with MDAs and a more positive attitude toward MDAs were positively associated (Ammann et al., 2023; Giacalone et al., 2022; Graça et al., 2015, 2019; Rehman et al., 2024). Notably, the participants

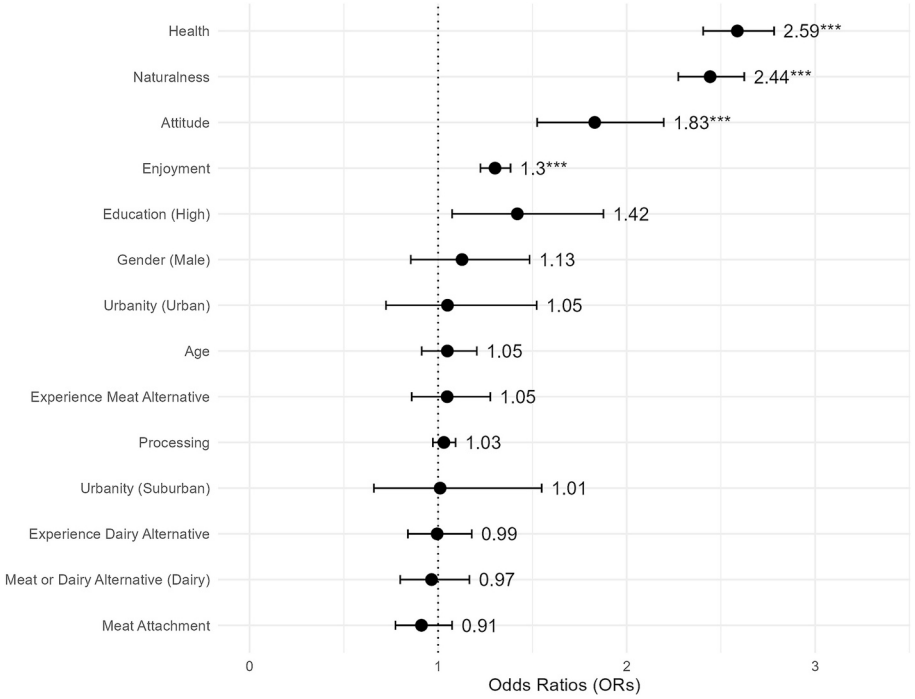

Fig. 6. Odds ratios and 95% confidence intervals for predictors of perceived sustainability of alternative products.

reported higher WTC meat than dairy alternatives. While studies in other countries have shown a higher WTC dairy than meat alternatives (Cardello et al., 2022), our finding can potentially be explained by higher sales growth for meat alternatives than for dairy alternatives in Switzerland (Federal Office for Agriculture, 2022; Herrmann & Bolliger, 2021), which may lead Swiss consumers to be more familiar with meat than with dairy alternatives.

Consumers showed difficulty accurately assessing the healthiness of MDAs, while sustainability assessments showed only weak alignment with the objective indicator (RQ2). This finding is consistent with earlier evidence of misalignments between objective product characteristics and subjective consumer perceptions (Giacone et al., 2024; Hartmann et al., 2022). Perceptions of healthiness may be especially challenging for MDAs because many of these products are relatively novel, and their animal-based reference products, such as dairy or chicken, are often associated with health benefits that do not necessarily transfer to MDAs (e.g., cow's milk is nutrient-dense, while oat drinks are not; Giacone et al., 2024). These misalignments may reflect information asymmetries, defined as imbalances between objectively available product information and the information consumers can access or process, and they underline the need to understand how the healthiness and sustainability perceptions of MDAs are formed.

We examined potential factors through the lens of halo effects. The results are consistent with several halo effects: healthiness perceptions were associated with perceived sustainability, naturalness, processing, and enjoyment (RQ3), whereas sustainability perceptions were associated with perceived healthiness, naturalness, and enjoyment (RQ4). Additionally, more positive attitudes toward MDAs enhanced perceptions of both healthiness and sustainability, indicating a generalized halo effect. Regarding potential differences in the perceptions of meat and dairy alternatives, it initially seemed that dairy alternatives were perceived as healthier than meat alternatives. However, the application of the Bonferroni-Holm adjustment revealed that this difference cannot be considered robust. No differences were observed in perceived sustainability between meat and dairy alternatives.

Regarding demographic factors, younger participants showed higher WTC MDAs, consistent with prior research (Giacalone et al., 2022; Rehman et al., 2024; Zaleskiewicz et al., 2025). However, age was not associated with healthiness or sustainability perceptions, partially contradicting findings that younger individuals rate dairy alternatives as healthier and more sustainable (Giacone et al., 2024). Gender was not associated with WTC or sustainability and healthiness perceptions. The missing association of gender with WTC may result from the inclusion of different MDAs; research suggests males are more accepting of insect-based foods and cultured meat (Kouarfaté & Durif, 2023; Zaleskiewicz et al., 2025), whereas females are more accepting of plant-based alternatives (Melendrez-Ruiz et al., 2019; Onwezen et al., 2021). The missing association of gender with healthiness and sustainability perceptions aligns with previous research on food perceptions (Giacone et al., 2024; Wassmann et al., 2023). Similarly, education showed no associations. This contrasts with research linking higher education to greater MDA acceptance (Giacalone et al., 2022; Zaleskiewicz et al., 2025). While some research indicates that less-educated individuals rate dairy alternatives as healthier and more sustainable (Giacone et al., 2024), our findings are consistent with research showing no association with sustainability perceptions (Wassmann et al., 2023). Urbanity also showed no associations. This contrasts with studies identifying urban consumers as more accepting of MDAs (Beacom et al., 2021; Giacalone et al., 2022), but aligns with recent evidence of similar rural-urban MDA adoption (Zaleskiewicz et al., 2024). The missing associations with healthiness and sustainability perceptions contradict findings that urban residents evaluate the healthiness and sustainability of dairy alternatives more positively (Giacone et al., 2024). The lack of demographic associations in our results may reflect the “mainstreaming” of MDAs in Switzerland (Federal Office for Agriculture, 2022; Herrmann & Bolliger, 2021). As MDAs move from niche to mass-market, demographic differences diminish while perceptions become more important.

Beyond general attitudes toward MDAs, behavioral and attitudinal factors showed no association with perceptions of healthiness and sustainability. Neither experience with MDAs nor meat attachment or diet was associated with these perceptions. This contrasts with earlier studies showing that vegetarians, vegans, and flexitarians tend to evaluate MDAs more favorably than omnivores (Götze & Brunner, 2021; Hartmann et al., 2022; Onwezen et al., 2021). Moreover, our findings provide no evidence for a reverse halo effect, that is, the devaluation of MDAs among consumers with high meat attachment, reported in earlier

studies (Götze & Brunner, 2021; Graça et al., 2019; Hoek et al., 2011; Kim et al., 2024). One possible interpretation is that attitudes toward plant-based diets do not necessarily translate into healthiness and sustainability perceptions of specific MDAs (Onwezen et al., 2021).

6.1. Limitations

This study advances previous research by examining how healthiness and sustainability perceptions are associated with consumers' WTC across a range of MDAs while also identifying multiple halo effects that may influence these perceptions. In contrast to earlier studies, we did not compare perceptions of MDAs with perceptions of animal-based products (Giacone et al., 2024; Hartmann et al., 2022). Instead, the present study distinguishes itself by considering a broad spectrum of MDAs, including an insect-based product and lab-grown meat.

This study has limitations that should be acknowledged. First, while our study prioritized health and sustainability as the selling points of MDAs, we acknowledge that the exclusion of hedonic factors such as taste or perceived enjoyment from our model predicting WTC limits the model's comprehensiveness in explaining overall consumer choice intentions. Second, objective assessments of product healthiness depend on more than nutrient composition; preparation methods, added ingredients, and portion sizes may also play a role but were not considered here (Hartmann et al., 2022). Similarly, objective assessments of food sustainability depend not only on greenhouse gas emissions but also on other factors, such as land use, water consumption, eutrophication potential, and acidification potential (Poore & Nemecek, 2018). Third, the inclusion of relatively homogeneous product categories may have limited the participants' ability to detect subtle differences in healthiness or sustainability. However, this design reflects shopping contexts in which consumers compare similar products within a product line (e.g., different plant-based meat or dairy alternatives). Fourth, allowing participants to interpret "healthiness" and "sustainability" individually mirrored real-life decision-making but introduced interpretive variability, which may have contributed to the absence of demographic associations (Lazzarini et al., 2016; Siegrist & Sütterlin, 2017). Fifth, due to the nonexperimental study design, the direction of the relationships between the perceptions cannot be determined causally. Although our hypotheses and analyses assume that perceived attributes such as naturalness and processing, are associated with perceived healthiness and sustainability through halo effects, reverse causality or bidirectional relationships (e.g., perceiving a product as healthy, leading to assumptions about its naturalness) cannot be ruled out. Therefore, the reported relationships should be interpreted as associations rather than causal pathways. Sixth, although consumers across European countries tend to evaluate meat alternatives similarly (Michel et al., 2021), the generalizability of the findings to other countries within and outside Europe may be limited due to country-specific food consumption habits. Seventh, the WTC measure reflects intention rather than behavior. Since our study excluded price information and did not assess willingness to buy, the external validity of our findings regarding actual purchasing behavior is limited.

6.2. Theoretical and practical implications

Two major theoretical implications are that, first, future research should apply experimental approaches to test the causal nature of the identified halo effects and explore attitudinal or contextual moderators. Second, future research should investigate real-world purchasing or eating decisions (i.e., behavior) instead of WTC (i.e., intention).

Our findings also have practical implications for the marketing and communication of MDAs (see Table 7). The results indicate that WTC MDAs is associated with perceived healthiness and, to a lesser extent, sustainability. Effective communication in product marketing or public health should, where applicable, integrate health as a personal benefit and sustainability as a societal benefit. Building on the *health–sustainability halo* found in this study, which suggests that favorable evaluations of one dimension reinforce the other, communication that emphasizes either motive may indirectly enhance both (Jahn et al., 2021; Piracci et al., 2023). Whichever motive is more salient for a given target group may serve as a key entry point for promoting healthy, sustainable choices (Jahn et al., 2021; Rehman et al., 2024).

Table 7
Implications of the study results for the marketing and communication of MDAs.

Findings	How to use the findings	Actors
Consumers' WTC MDAs were associated with perceived healthiness and, to a lesser extent, sustainability.	Where applicable, integrate health and sustainability benefits.	Marketers, public health communication
Health–sustainability halo: Favorable evaluations of one dimension reinforced the other.	As communicating health or sustainability benefits may indirectly enhance the other, emphasize the more salient motive for your target group.	
Naturalness halo: Perceived naturalness increased both healthiness and sustainability perceptions, whereas perceived processing reduced healthiness perceptions.	Emphasizing natural qualities and explaining necessary processing steps may mitigate consumer skepticism.	Marketers, public health communication
Positive attitudes toward MDAs and experience with MDAs were associated with greater WTC MDAs.	Targeted product sampling and sensory marketing.	Marketers
Taste halo: Enjoyment of positive taste experiences strengthened perceived healthiness and sustainability.	In general, facilitate experiences with MDAs.	
Consumers had particular difficulty with accurately assessing the healthiness of MDAs, while sustainability assessments showed only weak alignments with the objective indicator.	Nuanced communication regarding the often novel MDAs.	Public health communication

The *naturalness halo* found in this study indicates that perceived naturalness increases both healthiness and sustainability perceptions, whereas perceived processing reduces healthiness perceptions. Accordingly, emphasizing natural qualities and explaining the necessary processing steps may mitigate consumer skepticism, especially in cases where processing serves essential purposes, such as nutrient fortification or ensuring food safety (Jahn et al., 2021; Sadler et al., 2021).

The finding that a more positive attitude toward MDAs and more experience with MDAs were associated with a higher WTC suggests opportunities for targeted marketing activities, such as in-store samplings near MDA shelves. The potential of product sampling is also indicated by the *taste halo* found in the present study, which suggests that the enjoyment of a positive taste experience strengthens perceived healthiness and sustainability. In general, experiences with MDAs should be facilitated.

Finally, that consumers had particular difficulty accurately assessing the healthiness of MDAs, while sustainability assessments showed only weak alignments with the objective indicator, combined with the considerable variation in the actual health-related properties and environmental impacts of MDAs (Bohrer, 2019; Mehner et al., 2024), emphasizes the importance of nuanced public health communication regarding these often novel products.

7. Conclusion

Consumers' perceptions of the healthiness and sustainability of MDAs are associated with their WTC such products. However, consumers often struggle to accurately assess these attributes. Instead of

objective indicators, healthiness is associated with perceived sustainability, naturalness, processing, and enjoyment, while sustainability is associated with perceived healthiness, naturalness, and enjoyment. These findings are consistent with multiple halo effects and hold relevance for the marketing and communication of MDAs.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used DeepL Write, Microsoft 365 Copilot, Gemini 3 Pro, and ChatGPT 4.0 in order to improve the phrasing and writing style. After using these tools/services, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

CRediT authorship contribution statement

Bettina Höchli: Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization, Project administration. **Geraldine Holenweger:** Writing – review & editing, Methodology, Investigation, Conceptualization, Data curation, Formal analysis, Project administration. **Anna Morf:** Writing – original draft, Visualization, Methodology, Formal analysis, Data curation. **Aline Stämpfli:** Writing – review & editing, Methodology. **Claude Messner:** Writing – review & editing, Methodology, Conceptualization.

Ethical statement

Ethical approval for the involvement of human subjects in this study was granted by the Ethics Committee of the University of Bern, Faculty of Business, Economics and Social Sciences, Reference number 322023, 11/01/23.

Declaration of competing 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.

Acknowledgements

We would like to thank Eric Mehner and Mélanie Douziech for providing data on the objective health values and sustainability impacts of the 15 products used. These were operationalized by NRF10.3 values and global warming potential in kilograms of CO2-equivalent, respectively. Further, we would like to thank TA-SWISS for initiating and financially supporting a multidisciplinary research project with the aim of investigating the health and ecological effects of substitute products to meat and dairy, as well as consumers' perceptions of them. The survey reported in this article is part of this multidisciplinary project, but was not conducted with financial support from TA-SWISS.

Appendix A

Nutritional values (NRF10.3) and sustainability values (kg CO2eq) of MDAs.

Table A.1
MDAs ordered by NRF10.3 score. Higher values indicate greater nutritional quality.

Product	NRF10.3
Falafel	1.198
Plant-based cold cuts	1.115
Plant-based sausage	1.097
Plant-based burger	0.974
Plant-based schnitzel	0.939
Plant-based chicken chunks	0.916
Tofu	0.822
Quorn	0.664
Lab-grown meat	0.583
Insect balls	0.487
Soy yogurt	0.401
Seitan	0.393
Oat drink	0.268
Soy cream	0.109
Cheese alternative	0.103

Table A.2
Products ordered by greenhouse gas emissions (kg CO_2eq). Lower values indicate lower environmental impact and thus greater sustainability.

Product	kg CO_2eq
Oat drink	0.310
Soy yogurt	0.382
Falafel	0.384
Plant-based sausage	0.565
Soy cream	0.716
Seitan	0.874
Plant-based schnitzel	0.938
Plant-based burger	1.002
Plant-based chicken Chunks	1.044

(*continued on next page*)

Table A.2 (*continued*)

Product	kg CO_2eq
Insect balls	1.140
Plant-based cold cuts	1.145
Tofu	1.101
Quorn	1.690
Cheese alternative	2.847
Lab-grown meat	14.240

Appendix B

Distributions

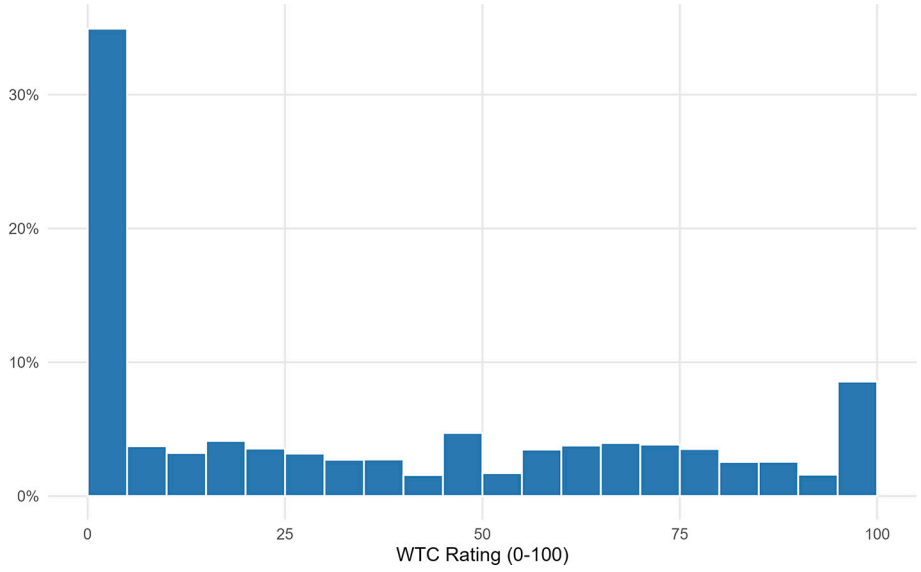

Fig. B.1. Distribution of willingness to consume (WTC) ratings. A total of N = 1034 participants evaluated 15 different products.

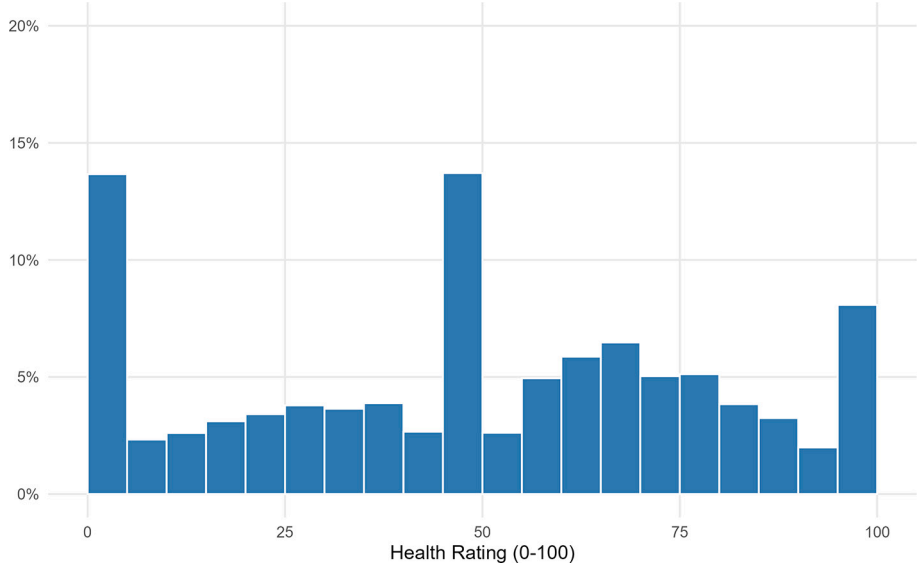

Fig. B.2. Distribution of perceived health ratings. A total of N = 1034 participants evaluated 15 different products.

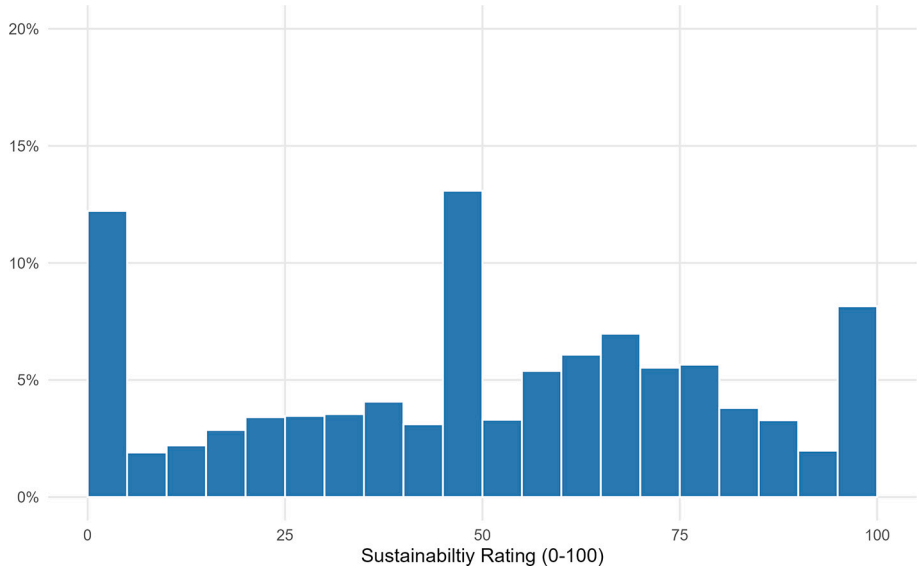

Fig. B.3. Distribution of perceived sustainability ratings. A total of N = 1034 participants evaluated 15 different products.

Table B.1
Distribution of ratings across categories (low, medium, high) for WTC, perceived sustainability, and perceived health. A total of N = 1034 participants evaluated 15 different products.

Category	Low	Medium	High
WTC	8432	3069	4018
Perceived sustainability	4350	5876	5284
Perceived health	4809	5628	5073

Appendix C. Supplementary data

Supplementary material to this article can be found online at https://doi.org/10.1016/j.foodqual.2026.105934.

Data availability

Anonymized data is publicly available on OSF at https://osf.io/wuqkd.

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