

Leveraging By-Products: Understanding Consumer Preferences for Sustainable and Story-Driven Products

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Abstract. *Although sustainability and food waste reduction have garnered interest, acceptance of upcycled food products by consumers still presents an important challenge. Previous research has explored consumer perceptions of sustainable food, but there are few studies evaluating the impact of story-telling-based marketing and sensory experiences on purchase behaviour. This study intends to fill this gap by investigating how sustainability narratives influence purchase intent and consumer perceptions of wafers containing 10% malt spent grain (a byproduct of beer and whisky industry). A mixed-methods approach was employed to combine a quantitative survey (133 student responses) and sensory evaluation (30 students participating in a taste test) to measure consumer attitudes, product acceptance and the role of story-telling in shaping perceptions. The results suggest that sustainability affinity is strongly correlated to purchase intention; consumers with high sustainability affinity reported better ratings for tested wafers than the conventional (store-bought) version. This study also demonstrates that transparent story-telling and digital strategies can improve the marketability of foods derived from by-products. The core results from quantitative analysis illustrated that advertising approaches which emphasize story-telling (e.g. interactive QR-coded packaging, behind-the-scenes narratives) could strengthen consumers' perceptions of trust and subsequently their purchase intent. This study builds upon the existing literature regarding sustainable consumer behaviour by adding valuable insights into how businesses can effectively market upcycled food. The additional value of this study was the integrated approach between circular economy, marketing and food engineering to provide practical advice for businesses. Food producers could utilize targeted messaging that emphasizes a product's sensory appeal and educate their consumers, accelerating the adoption of innovations in sustainable food while addressing concerns surrounding food waste and environmental sustainability. Future research should be conducted to improve generalizability of this study, by extending the sample population to a broader demographic beyond university students.*

Keywords: consumer preferences, sustainability narratives, story-telling, food waste valorisation, sensory evaluation, circular economy, whisky industry by-products.

Introduction

The increasing emphasis on environment sustainability as well as food waste has generated greater interest among consumers in support of food products derived from upcycled ingredients. Food innovation may utilize industrial by-products such as malt spent grain originating from the whisky industry, effectively transforming waste into value-added, nutritionally rich and environmentally sustainable food items (Roy et al., 2023).

It is essential to consider consumer preferences, perceptions, and the motivations behind decision-making processes when a company is looking to market a new product. Consumer expectations for new and enriched food products could be met from the valorisation of industrial by-products (Cela et al., 2025). Significant food market changes have also occurred, in part, due to consumer concerns on health, sustainability, and food waste reduction (Stanciu et al., 2022; Nastase et al., 2025). At the same time, water scarcity, climate change and land degradation are transforming the food production system. These emerging food preferences and environmental issues are

influencing the entire food chain, compelling producers to find efficiencies using available resources, as well as new designs for healthy and sustainable food products (Errico et al., 2025).

Food waste valorisation is needed to prevent both economic and environmental shocks and to move in the direction of a circular economy (Stanciu et al., 2022). There are 1.3 billion tons of food which are lost or wasted each year, and food consumption is associated with 20–30% of the environmental impact in the European Union (Roy et al., 2023). Therefore, identifying consumer preferences regarding food products is an important aspect of reaching sustainability goals (Verain et al., 2021).

This study aims to further contribute to larger environmental and social discussions regarding sustainable consumer behaviour, building on Nastase et al. (2025) research on emerging trends, by emphasizing the importance of story-telling with respect to purchase decisions. It provides an overview of how consumer behaviour trends and insights into their preference can be converted into tangible actions for any organisation which intends to market food products that originate from by-products, as well as giving producers and investors the ability to produce unique food products that meet market demand while addressing economic efficiency and sustainability concerns. Additionally, this study highlights how environmentally-aware consumers base their consumption choices on a story-driven transparency-based marketing approach, as well as on their sensory experience with food products.

The article is organised into a general framework, starting with the introduction outlining the context of the study and the significance of sustainability in food innovation; literature review, which investigates consumer preferences, barriers to adoption, and story-telling perspectives about sustainability; the section outlining the methodology behind the study, in this case, quantitative sampling with qualitative sensory evaluations; results and discussion which provides overall conclusions on the significant association between sustainability affinity and purchase motivation related to story-telling, implications for market behaviour; and the conclusion summarizing key findings for business recommendations, research limitations considerations and future research opportunities to expand demographic reach.

Literature review

Social barriers to sustainable development in the circular bioeconomy could be more challenging than technological constraints. A successful transition to upcycled food products will depend on consumer awareness, perception and adoption of such goods (Aschemann-Witzel et al., 2023). In recent years, research in consumer behaviour, marketing, consumers and market trends related to upcycled foods has increased (Nastase et al., 2025), however, the topic of understanding consumer concerns or effectively communicating the benefits of adopting upcycled food products has not been exhausted (Grasso et al., 2023). It is important to examine how consumers interpret key elements affecting their purchasing choices not just in terms of attitude change, but whether it could lead to healthy food consumption behaviour (Du et al., 2024). Socio-demographic factors, attitude, values, social rules and norms, context in communities, phases of consumption, and culture all contribute to shaping food choices (Verain et al., 2021).

Marketing research has shown there is a larger, increasingly favourable upcycled food market. However, while consumers are gradually more interested in sustainability, a complex set of socio-cultural, economic and psychological barriers inhibit acceptance of upcycled food products. Cultural factors should not be underestimated, as food traditions, norms, and cooking preferences will inform consumer's acceptance to novel ingredients (Coderoni & Perito, 2021). Consumers' cultural mindset poses challenges for broader market penetration. Examples of barriers to broader penetration included

consumer lack of understanding of the upcycled food concept, food safety perceptions, uncertainty, or associated negativity towards some upcycled food products. Other negative factors can be neophobia towards food, which shows reluctance to try new or unfamiliar foods, and appears stronger in older consumers, who might see upcycled products as unusual or unappealing; while other consumers might reject upcycled products based on the origin of ingredients (Coderoni & Perito, 2021), the production process of the good (Du et al., 2024), or due to acquired perception from historical social factors surrounding food (Aschemann-Witzel et al., 2023).

Research shows that socio-demographic characteristics, such as gender, age, education level, and socioeconomic status impact the acceptance or rejection of upcycled products (Aschemann-Witzel et al., 2023). In this regard, studies show that generations vary greatly in their response towards upcycled foods as younger consumers are shown to have a greater preference for sustainable products. For Zhang et al. (2021), cultures having a strong preference for traditional foods and unprocessed foods were more resistant to accept upcycled products, viewing them as unnatural or inferior. Older consumers and consumers with lower education levels may have several psychological and informational barriers that contributed to their scepticism about upcycled food; senior consumers tend to exhibit food neophobia (Aschemann-Witzel et al., 2023) and less educated consumers exhibit misconceptions concerning by-product food safety and nutrition (Du et al., 2024). On the other hand, higher-educated consumers are more eco-conscious and critical in their views regarding sustainability claims (Du et al., 2024), and some require clear communication to build trust (Verain et al., 2021; Cela et al., 2025). This is further corroborated by research showing that Generation X and Baby Boomers had a lower intent to purchase upcycled food than Generation Z and Generation Y (Zhang et al., 2021).

In addition, perceived environmental benefits strongly impact willingness to pay for upcycled products (Cela et al., 2025). Price sensitivity can outweigh environmental concerns and may affect the adoption of upcycled foods or consumption protocols, particularly in regions in where affordability is prioritised over sustainability (Rakesh & Mahendran, 2023). The additional costs of processing, quality control, and promotion can produce increases in costs, triggering consumers to only see a "green premium" without noticing any immediate benefits (Du et al. 2024).

Investigating consumer behaviour, as well the socio-demographic and social influences, can help producers and policymakers develop strategies to enhance the appeal of upcycled products and promote a more sustainable food system (Rakesh & Mahendran, 2023). Verain et al. (2021) define sustainable food as *"food that is produced, processed, packaged, transported, and traded with respect for people, animals, and the environment, without compromising future generations."* However, there is still a lot to be studied when it comes to consumer understanding of sustainability. Consumers display confusing and contradictory perspectives on sustainability, often associating sustainability only with the environmental impact rather than consideration for ethics.

Several studies use both quantitative and qualitative methodologies to study consumer expectations, preferences, and attitudes towards upcycled foods. General findings suggest that acceptance of upcycled foods is associated with pre-existing culinary traditions, prolonged by perceived naturalness, as well as successful communication of sensory or other benefits (Aschemann-Witzel et al., 2023).

Literature review showed the following key themes with regard to malt spent grain-based foods: sensory analysis and health benefits. Combest & Warren (2019) studied the preferences of U.S. college students of upcycled foods derived from brewers' spent grain. Consumers were satisfied with the foods but noted some sensory defects. Those accustomed with whole grains were more familiar with sensing the taste, which made consumers more receptive to the proposed food

innovations (Combest & Warren, 2019). Ample research has examined consumer attitudes towards sustainability as well as food waste valorisation (Coderoni & Perito, 2021; Aschemann-Witzel et al., 2023; Cela et al., 2025), yet gaps remain on how marketing narratives about food waste impacts consumers' willingness to adopt upcycled food. Studies have concentrated primarily on the economic and environmental factors of food waste, yet there is limited work on consumer psychology or the emotional aspects of decision-making process.

There are several psychological factors on consumer adoption of upcycled food, such as perceived risk and sensory expectations (Errico et al., 2025). Consumers often tend to be influenced by their perception of taste, freshness, and safety associated with upcycled foods. Education outreach, clear marketing messaging, and reasonable pricing may help reduce some consumer barriers (Combest & Warren, 2019). Grasso et al. (2023) recommend that awareness campaigns about upcycling also be aimed at efforts that cater to cultures and senses.

In summary, this study explores how sustainability narratives and sensory experience shape purchase intent, offering a holistic view of consumer behaviour toward upcycled food and advancing both research and marketing.

Methodology

This research followed a mixed-methods approach that combined quantitative survey data with qualitative responses after taste test to better understand consumer perceptions. This study is part of a broader research investigating local consumer attitudes toward sustainable food products, utilising a case study of wafers containing 10% malt spent grain by-product of the whisky industry (Nastase et al., 2025). The wafers used for the taste tests were lab-produced by colleagues from the Faculty of Food Engineering at „Ștefan cel Mare” University of Suceava, Romania.

Previous research examined consumer awareness and perceptions while identifying important consumer attitudes (Nastase et al., 2025). The current article refines the outcomes of the initial study into a testable behavioral hypothesis that relates to sustainability driven narratives and their effect on purchase likelihood. Building on similar lines of research regarding sustainable consumer behaviour and by-product valorisation (e.g. Errico et al., 2025; Cela et al., 2025), this study examines the following hypothesis:

H1: Consumers with strong affinity toward sustainability-focused narratives will be more likely to purchase food products derived from by-products.

To test H1, **sustainability preference (affinity)** is defined as an independent variable (IV) measured using responses that focused on the perceived importance of sustainability factors such as *reducing food waste*, *lowering environmental effects*, and *sustainable packaging*. The dependent variable (DV) was the likelihood of purchasing food products made from by-products, where respondents explicitly indicated their **purchase intentions** on a five-point Likert scale (Very likely, Likely, Neutral, Unlikely, Very unlikely). The respondents were grouped into the three sustainability affinity levels: High (ratings ≥ 4), Moderate (rating = 3), and Low (ratings ≤ 2). The goal of the study was to test if consumers who prioritise sustainability were statistically more likely to purchase sustainable foods, thus substantiating the commercial viability of sustainability-driven food innovations. A Chi-square test was employed to analyse the hypothesis H1 to find if a significant association between sustainability of affinity and purchase likelihood can be identified.

A **quantitative** approach was utilised using a structured online survey conducted using Google Forms, designed to assess consumer knowledge, preferences, and attitudes towards sustainable food products. The survey was conducted from November 1 to November 30, 2024,

and was announced to participants through QR code flyers distributed across “Ștefan cel Mare” University of Suceava, to be accessible and enhance participation, while also reducing selection bias (Nastase et al., 2025). All survey responses were entirely anonymous, and participants were informed that their answers would not be used for profit.

Primarily, 133 respondents completed the first three sections of the survey (questions 1 to 19), to establish a local baseline of consumer knowledge and perceptions of foods derived from by-products, and the importance of sensory characteristics. To limit bias and to ensure authentic consumer insights, all responses were anonymised and no participants were incentivized to complete the survey. The sample was chosen to reflect environmentally aware consumer preferences, particularly among university students and young professionals, who represent a growing market segment interested in sustainable food innovations. Regardless, the small sample size may limit the generalised context of the results and future research could seek a broader spectrum of demographics.

The survey included 25 questions (24 closed-ended, and 1 open-ended), separated into five sections to assess specific consumer preferences. Table 1 and Table 2 below provide an overview of the questions and variables used.

Table 1. Demographic variables included in the analysis

No.	Characteristic (Variable)	Question type and response
1	Age	Ordinal – 3-level scale
2	Gender	Dichotomous – Female, Male, Other
3	Study cycle	Nominal
4	Year of study	Ordinal – 4-level scale
5	Monthly income	Ordinal – 4-level scale

Source: Authors’ own research.

Table 2. Description of questionnaire variables

No.	Variable	Question type and response
6	Familiarity with industrial by-products	Ordinal – 4-level scale (Very familiar, Moderately familiar, Slightly familiar, Never)
7	Attitude towards the inclusion of industrial by-products in food production	Nominal (Positive, Neutral, Negative)
8	Willingness to purchase manufactured products from industrial by-products	Nominal (Yes, Maybe, No)
9	Perceived benefits of derived products	Nominal (Food waste reduction, Price affordability, Reduced environmental footprint, Other)
10	Importance of food product features	Ordinal – Scale 1-5 (Appearance, Colour, Taste, Smell, Texture, Acceptability, Price, Brand, Nutritional value, Sustainability, Origin)
11	Probability of purchasing a sustainable product	Ordinal – 5-level scale (5. Very likely – 1. Not at all likely)
12	Importance of product sustainability	Ordinal – Scale 1-5 (Food waste reduction, Environmental impact, Sustainable packaging)
13	Importance of nutritional value	Ordinal – Scale 1-5 (Fiber content, Protein content, Allergen free content, Perceived health benefits)
14	Importance of product origin	Ordinal – Scale 1-5 (Local, Innovative, Product story, Supply chain transparency)
15	Preference for products similar in price and quality	Ordinal – 5-level scale (5. Very likely – 1. Not at all likely)

No.	Variable	Question type and response
16	Importance of product attributes in purchase decisions	Ordinal – Scale 1-5 (Appearance, Colour, Taste, Smell, Texture, Acceptability, Price, Brand, Nutritional value, Sustainability, Origin)
17	Preference for products derived from by-products	Dichotomous – Yes, No (for each question: comparable taste, healthy, local product, sustainable)
18	Impact of sustainability on purchase decisions	Ordinal – 5-level scale (5. Very much – 1. Not at all)
19	Reasons for consuming wafers with spent malt grain	Nominal (Better taste, Better price, Nutritional value, Sustainable product, Local product)
20	Willingness to try wafers with spent malt grain added	Nominal (Yes, Maybe, No)
21	Willingness to pay for wafers with spent malt grain	Nominal (More, About the same price, Less)
22	Essential attributes for the attractiveness of wafers with added spent malt grain	Nominal (Pleasant taste, Better price, Sustainable packaging, Promotion of nutritional benefits, Other suggestions)
23	Assessment of wafer attributes (spent malt vs. conventional store-bought)	Ordinal – Scale 1-5 (Appearance, Colour, Taste, Smell, Texture, Acceptability)
24	Likelihood of recommending the product	Ordinal – 5-level scale (5. Very likely – 1. Not at all likely)

Source: Authors' own research.

Next, for the qualitative analysis (questions 19 to 25), 30 students also participated in a controlled taste test comparing the wafer with 10% spent malt grain added to a conventional (store-bought) wafer. According to the method of evaluating food products quality using a scoring scale for assessing sensory characteristics of a product, groups of tasters consisting of 3-9 evaluators were used (Codină, G.G., 2016, pp.45).

The sensory assessment aimed to evaluate taste, texture, aroma, and overall acceptability, ranked on a 5-point Likert scale. It consisted of a sensory evaluation section (5 questions), which captured interest for wafers with malt spent grain and willingness to pay, and importance of key product characteristics related to taste, price, packaging and nutritional benefits, including sensory evaluations comparing spent malt wafers with the store-bought alternatives. Participants rated both wafer variants on a 5-point Likert scale (1=Strongly dislike, 5=Strongly like) along the attributes of taste (sweetness, bitterness, aftertaste), texture (softness, crunchiness and chewiness), aroma (intensity of smells, presence of malt), appearance (colour, overall visual appeal), overall acceptability (whether they would eat it again). To minimize bias, the test was conducted under blind conditions, meaning that participants were not informed which wafer contained malt spent grain. To help cleanse the palate between samples, water and plain crackers were served. The order of presentation was randomised to prevent order effects (Codină, G.G., 2016, pp.46).

Lastly, an open-ended question provided **qualitative** data about consumer expectations to and suggestions for improving sustainable food products with compelling narratives. Responses to the open-ended question were analysed using thematic coding to identify common themes regarding consumer expectations and barriers to adoption of sustainable food products. Qualitative content was merged with the quantitative results to build a more holistic understanding of consumer behaviour.

This methodology aligns with previous literature investigating consumer behaviour towards upcycled food products (Errico et al., 2025; Cela et al., 2025), which used survey-based methodologies including sensory evaluation while measuring product acceptability. Notably, Cela et al. (2025) used a similar methodology to explore and understand consumer responses to beer produced from agroindustrial by-products and reported sustainability narratives added value to the

product, while Errico et al. (2025) investigated consumer acceptance of plant-based edible hydrogels; and demonstrated that trust in sustainability claims significantly influenced preferences.

This research offers valuable insights, however several limitations should be recognized. The study generalisability is slightly limited due to its sample of university students, who may not represent larger consumer populations; their higher sustainability awareness levels, openness to novelty food products, and digitalised engagement with sustainability stories may program their product preferences. Additionally, self-reported survey data may be influenced by social desirability bias, where participants express favourable views toward sustainability concepts even if their actual purchasing behaviour does not align. Furthermore, another constraint was the small sample size (133 survey participants) which limits representativeness. The taste test, while providing valuable insights and data points, generated evaluations from a homogenous group of 30 university students, and does not consider sensory preferences across cultural backgrounds or geographic location. Future research should consider including samples from a wider and more diverse demographic of working professionals, older consumers, and rural/urban population.

Results and discussions

This section presents the main results of the statistical analyses conducted in SPSS, testing:

H1: Consumers with strong affinity toward sustainability-focused narratives will be more likely to purchase food products derived from by-products.

The contingency table (Table 3) presents the distribution of consumer responses, based on sustainability affinity and purchase likelihood as variables.

Table 3. Contingency Table - Sustainability Affinity vs. Purchase Likelihood

Sustainability Affinity	Very Likely	Likely	Neutral	Unlikely	Very Unlikely
High	35	31	9	4	2
Moderate	9	11	4	3	1
Low	2	3	4	6	9

Source: Authors' own research.

Consumers with high sustainability affinity significantly favour sustainable products; with 66 (35+31) of 81 (High category total) respondents (81.5%) indicating positive purchase intentions, such as "Very likely" or "Likely" to purchase. Consumers with moderate sustainability affinity are less certain, with 20 (9+11) of 28 (71.4%) indicating purchase intent but still showing slight hesitation. Consumers with low sustainability affinity demonstrate the most resistance, where 15 out of 24 (62.5%) indicated neutrality or unfavourable perceptions towards buying. This pattern indicates that consumers who value sustainability are markedly more likely to embrace sustainability-driven food innovations.

Table 4 provides the results of the Chi-square test that were obtained to assess the association between sustainability affinity and likelihood of purchase. Cramér's V was also calculated to determine the strength of the relationship. A p-value threshold of 0.05 was employed to determine whether a statistically significant result has been obtained.

Table 4. Statistical results of Sustainability Affinity and Likelihood to Purchase

Test	Value	Interpretation
Chi-square (χ^2)	45.03	Indicates a significant association between sustainability affinity and likelihood to purchase.
p-value	3.63×10^{-7} ($p < 0.05$)	High significance, the observed relationship is not due to chance.
Cramér's V	0.41 (<i>moderate to strong</i>)	Suggests a meaningful association between sustainability affinity and purchase intention.

Source: Authors' own research.

This analysis shows evidence of a statistically significant relationship between sustainability affinity and purchase likelihood. Consumers with a higher affinity for sustainability-driven narratives are far more likely to purchase food products derived from industrial by-products. The results confirm that sustainability messaging is not only an ethical appeal, but a real motivator for consumers. Respondents who strongly value sustainability were far more likely to purchase food products that were by-product-based, reinforcing the idea that sustainability narratives can be effective. Meanwhile, consumers with a moderate affinity showed a low level of hesitation, with 71.43% showing a positive purchase likelihood. In contrast, consumers with low sustainability affinity exhibit greater reluctance, with 79.16% showing neutral or unlikely purchase intent. This highlights the importance of awareness-building efforts, as knowledge about sustainability directly influences purchase intent. Importantly, while sustainability is an important factor to the respondents, the results also show that taste and sensory experience remain the most important food choice determinants: 79% of the 30 students who tasted the wafers with malt spent grain stated they would recommend them.

When considering how to market food products derived from by-products, the results suggest it may be beneficial to consider first targeting High-Affinity Consumers, who were shown in this study to be passionate about sustainable products, and therefore they would likely be the first audience to convert in a campaign, loyalty program or brand-building effort. Companies should focus on sustainability benefits such as reducing food waste, lowering impact on the environment, and sustainable packaging, to capture the attention of High-Affinity Consumers. Alternatively, businesses could focus on educating and converting Moderate-Affinity Consumers with targeted messages, informative content or compelling story-telling that emphasize environmental benefits. This way neutral consumers with a moderate interest might be persuaded into becoming active buyers.

Sensory Test Results

A key aspect of this study was the controlled sensory evaluation. At the beginning of this test, 30 students participated to compare wafers enriched with 10% malt spent grain against a conventional (store-bought) wafer. The test results are displayed within Table 5 and aim to evaluate consumer acceptance, taste perception and overall product attractiveness through sensory attributes.

Table 5. Statistical results of sensory evaluation

Attribute	Spent Malt Wafer (Mean $\pm$ SD)	Conventional Wafer (Mean $\pm$ SD)	t-test (p-value)
Taste	4.18 $\pm$ 0.72	4.02 $\pm$ 0.79	0.041 (significant)
Texture	4.30 $\pm$ 0.69	4.10 $\pm$ 0.75	0.038 (significant)
Aroma	4.12 $\pm$ 0.78	3.92 $\pm$ 0.81	0.044 (significant)
Appearance	4.05 $\pm$ 0.80	3.95 $\pm$ 0.79	0.18 (not significant)
Overall Acceptability	4.25 $\pm$ 0.67	4.10 $\pm$ 0.72	0.049 (significant)

Source: Authors' own research.

The flavour of the wafer with malt spent grain received significantly higher ratings than the traditional wafer ($p = 0.041$). Many respondents enjoyed the slightly nutty, caramel-like undertones of the wafer with malt spent grain, which they viewed as a positive, rather than a negative. While the respondents noted a slight bitterness to the wafer, this was usually balanced by the wafer's inherent sweetness, thus producing a higher flavour preference in total. The wafer with malt spent grain also received significantly higher texture ratings ($p = 0.038$), and the respondents noted an especially slightly crisper exterior and a moist and fluffy interior. The inclusion of malt spent grain flour seemed to add to the structural integrity of the wafer's crunch while allowing consumers to enjoy a fulfilling bite without feeling too heavy.

In terms of aroma, the wafer with malt spent grain again received significantly higher scores than the traditional wafer ($p = 0.044$), and the participants generally expressed greater enjoyment of the warm, malty, and slightly toasted aroma where some specifically referenced aromas similar to freshly-baked bread or roasted grains. This is interesting as it indicates that there seems to be a natural olfactory appeal associated with malt spent grain as a product feature. For appearance, the wafer with malt spent grain again received slightly more favourable ratings but not significantly so ($p = 0.18$). While participants varied in their visual preference for the richer golden-brown colour of the wafer with malt spent grain, others did not find it visually distinct enough from the standard version to exhibit a strong preference. This suggests that while colour alone may not have an overall direct impact on consumer opinion, the product attractiveness could be enhanced through branding and overall product presentation since it was noted by participants in their comments.

Finally, overall acceptability was significantly higher for the wafer with 10% malt spent grain ($p = 0.049$) since it was positively scored across several sensory dimensions. Participants noted that the combination of taste, texture, and aroma contributed to a more enjoyable eating experience, reinforcing the commercial potential of wafers enriched with malt spent grain.

Impact of story-telling on purchase intent (qualitative results)

The open-ended responses revealed a strong consumer preference for compelling story-telling about the sustainability attributes to inform and enhance purchase intent. Some of the respondents argued that story-telling, if done properly, could have a strong influence on their choice to purchase a sustainable food product.

Many comments made by participants suggested that brands should actively share the mission of sustainability in detail through captivating narratives. This could include juxtaposing the journey of malt spent grain travelling from brewery to food production facilities, to features about the local farmers, sustainable brewers, and people involved in the product design. Such narratives could help build consumer trust and emotional connection, making the sustainability aspect more relatable and appealing.

A notable number of respondents recommended that the brand could incorporate digital technologies to improve the story-telling process, like QR codes appearing on the packaging so that consumers could access more interactive sustainability content. QR-linked materials suggested by the respondents included short video stories, infographics, or animated explainers revealing the eco-friendly journey of producing food items. Participants believed they would value access to visual, trustworthy material as this makes them feel more confident in their decision, and it leads to increased willingness to choose sustainable food purchases over conventional foods.

Some participants shared their interest in the development of social media story-telling campaigns whereby actual consumers promoted their shared experiences with the products. Suggestions included behind-the-scenes production videos, sustainability challenges when

individuals partnered with influencers in the environmental space to help promote the educational and ethical components of upcycled food products to provoke more positive feedback. Also, respondents believed that observing other people advocate for sustainability-driven food innovations would encourage broader consumer adoption.

Overall, the qualitative data reflects that strong story-telling and transparency are critical factors that impact consumer willingness to purchase sustainable food products. Businesses wishing to market upcycled food innovation should consider directing efforts on compelling brand narratives, digital engagement strategies, and transparency tools to effectively communicate the environmental and ethical value of their products.

Conclusion

This research provides powerful evidence for the impact of sustainability-driven narratives and their effects on consumer attitudes towards food products produced using industrial by-products (wafers containing 10% malt spent grain). The results confirm a significant relationship between sustainability affinity and purchase intent, strengthening the commercial potential of upcycled food innovations. The sensory results also illustrate that product quality (particularly taste, texture, and aroma) is imperative to consumer acceptance.

To translate the findings of our research into actionable strategies, businesses can leverage story-telling with interactive content via product packaging (QR codes) to promote their upcycling, sustainability and nutritional benefits. Businesses can create behind-the-scenes content, farm-to-table narratives, and sustainability challenges to engage consumers. Furthermore, marketing strategies can focus on targeting High-Affinity Consumers through social media and other campaigns, as well as educating moderate-affinity consumers with compelling and informative content. In addition, businesses can focus on trust, engagement, and expanding the market share for sustainable food innovations by emphasizing value-based benefits like the reduction of food waste and environmental footprint.

The qualitative part of our research reinforces the importance of transparent story-telling and digital engagement strategies, such as QR-coded product packaging and social media campaigns to enhance consumer trust and awareness. Open-ended survey results suggest that digitally-engagement strategies could boost consumer trust in foods made from industrial by-products, implying a commercial viability. Additionally, the sensory results highlight the importance of taste, texture, aroma, and their ability to overcome consumer scepticism.

While the study provides valuable insights, using a sample composed primarily of university students, which may not fully represent broader consumer demographics, poses limitations. Although the overall sample of the taste test was sufficient from a sensorial analysis perspective (Codină, G.G., 2016, pp. 45), it consists of a homogenous group which does not consider for sensory preferences based on cultural background, and geographic location, and in addition to this, the self-reported survey responses can be subject to social-desirability bias. Future research should expand the participant pool, explore cross-cultural comparisons, and test varied storytelling strategies to refine marketing approaches. By integrating sustainability messaging with high product quality and effective consumer education, businesses can drive greater acceptance of upcycled food products and support the transition toward more sustainable food systems.

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