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Tasting the Future: Sensory Evaluation and Perception of Insect-Based Products Among GenZ and Millennials

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Abstract: Insect proteins are suitable for human consumption and hold potential in the foodservice sector, where there is growing pressure to reduce traditional meat consumption, and this alternative could be explored through innovative gastronomy landscapes, such as by incorporating insect-based proteins into gourmet dishes. This study uniquely explored how young adults—specifically GenZ and Millennials (aged 18–30)—perceived and accepted insect-based products and whether their dietary habits aligned with sustainable principles. A mixed-methods approach was applied, including a cross-sectional study related to attributes of participants on insect products and sensory evaluation of insect and commercial products, to investigate awareness, acceptance, and sensory experiences. Key barriers included food neophobia and cultural resistance. The findings revealed a significant gap between awareness and behaviour: while 86% recognised insects as nutritious and 58% associated them with sustainability, only 18.6% have tried consuming them. This is a notable larger disparity compared to the adoption of other sustainable alternatives, such as vegetable meat based on peas, which have seen broader acceptance in recent years. Additionally, although 93.2% found products more appealing when their natural appearance is hidden, traditional insect-free products were still rated higher in taste, sweetness, and texture. Some insect-based products such as protein bars showed potential for greater acceptance than others. Bridging the awareness-behaviour gap requires targeted education, sensory improvement, and strategic marketing to emphasise nutritional and environmental benefits. Chefs could play a vital role by designing innovative menus that incorporate these products in familiar forms. This is demonstrated by successful examples where chefs have normalised unconventional ingredients, such as seaweed, overcoming cultural barriers and enhancing acceptance. Future studies should focus on expanding the diversity of participants, mapping gender differences, considering and improving the sensory properties of more products, and confirming the bioavailability of insects to promote wider acceptance of insect consumption.

Keywords: edible insects; entomophagy; sensory evaluation; consumer acceptance; young adults; insect consumption; insect-based products; sustainable alternative

Academic Editor: Andrea Pieroni

Received: 4 January 2025
Revised: 21 January 2025
Accepted: 26 January 2025
Published: 30 January 2025

Citation: Willeke, M.; Tsiami, A.; Lara, S.W. Tasting the Future: Sensory Evaluation and Perception of Insect-Based Products Among GenZ and Millennials. *Gastronomy* **2025**, *3*, 2. https://doi.org/10.3390/gastronomy3010002

1. Introduction

In recent years, the search for sustainable and environmentally friendly protein sources has resulted in a growing interest in entomophagy, the consumption of insects as food [1,2]. Around 2 billion people in 130 countries, particularly in Africa, Latin America and parts of Asia, regularly include insects in their diet [3]. Back in 2013, the Food and Agriculture Organisation (FAO) of the United Nations [4] already called on Western countries to promote

the consumption of insects, as they have an impressive nutritional profile and efficiency as a sustainable source of food [1,5]. Since then, the interest in edible insects has grown significantly. In 2021, the European Food Safety Authority (EFSA) [6], approved the migratory locust (*Locusta migratoria*) as novel food, marking a milestone of the consumption of insects in Western countries. Recent updates (2023) in the European Union (EU) [7] allow farming, sales and consumption of the lesser mealworm *(Alphitobius diaperionus)*. Other commonly produced and already authorised insect species include the yellow mealworm (*Tenebrio molitor* Larva) and the house cricket (*Acheta domesticus*) [8]. Only insects approved by the EU before 31 December 2023 can remain on the UK market as food. After that date, insects must be authorised by the British novel food authorisation [9]. Insects such as the German cheese mite and flour mite are permitted due to a significant history of consumption, but all other insects must go through the above legislative route [8,10,11]. While these regulatory frameworks are designed to ensure food safety and consumer confidence, they can also hinder the market entry of new products, as obtaining authorisations is time-consuming, costly and complex. This is a particular challenge for small manufacturers or start-ups that do not have the resources to go through lengthy authorisation procedures [12]. Nevertheless, Food service sector actors, such as chefs and manufacturers can incorporate the authorised insects in their dishes and products if appropriate labelling and food safety standards are followed [13].

The average meat consumption in the UK in 2022 was 100 g per day, exceeding the National Health Service (NHS) [14] recommendation of 70 g for adults per day [4,14]. The average meat consumption in Europe in 2023 was around 51.4 kg per person per year, while the global average is around 28.1 kg per person per year [15]. Overall, pork, beef, lamb and poultry are the most popular sources of animal protein world-wide, simultaneously being linked to significant impact on the environment, water insecurity, biodiversity loss, antimicrobial resistance and greenhouse gas emissions [16–19]. Overall consumption has increased steadily and is forecast to continue to rise alongside population growth, reaching almost 350 billion kg by 2025 [20]. This growth puts pressure on the food systems, from economic to social and environmental areas, and requires an interdisciplinary approach from different actors from along the food value chains to formulate feasible interventions [20–22]. At the same time, governmental and international organisation, such as the NHS [14] and EFSA [23] recommend daily protein intake between 40–100 g a day, depending on the policy framework, suggestions for traditional animal sources as the most bioavailable sources of protein are also made.

Fresh mealworms have a protein content of 18.7% (50.9% dry matter) [16,24,25]. Typical protein content of insect flour ranges 40 to 75%, the fat content from 7 to 77%, and the mineral content from 3 to 8% on a dry weight basis [22,26,27]. Furthermore, insects are associated with high micronutrient density, however, the bioavailability of these requires further research [24,25,28–30]. Novel policy frameworks also comment on plant sources of protein, especially legumes and grains, despite the positive inclinations of higher legume consumption, legumes tend to contain significantly less protein than insects and could have lower bioavailability, nevertheless, consumer perceptions towards legumes are likely less negative than of edible insects [24].

Key barriers to the consumption of insects and insect derived products include sociocultural aspects. In the Global North, insects are not traditionally viewed as food, which leads to significant aversion and resistance into incorporating those products into peoples' diets [31]. Often, cultural aversions and feelings of disgust are mentioned by populations not familiar with the concept of insect consumption. Insects are associated with dirt, disease, poverty, war and hunger [32–35]. For example, during the Second World War, food shortages led to the temporary consumption of protein-rich insects as a survival strategy,

a practice that is still associated with famine and poverty today [36]. Furthermore, there are some legitimate claims about safety and hygiene in relation to wild caught insects, however, those do not translate into industrial farming of edible insects, thus creating many misconceptions amongst the potential consumer base [25,37]. Within the Western cultural circles, these feelings act as significant barriers to higher uptake of insects. Despite policy efforts made to popularise insects [11,38], public opinion has not changed. Policy should focus on increasing awareness and access to products thus facilitating, sustainable, and resilient familiarisation with the novel products, as opposed to pressuring the general consumer, as this often leads to the opposite outcomes.

Other forms of barriers also persist, mainly in the form of limited accessibility to insects and insect-based products, especially on European markets, relatively high prices and lack of culinary ability to use the products in meal creation [39]. The food service sector, including restaurants, plays an important role here to increase people's awareness around edible insects and promote their higher intake. Leveraging culinary creativity of chefs, for example, through innovative dish creation, capitalisation on sensory and nutritional characteristics of insects and using sustainability orientated aspects, all of which could facilitate higher consumption and contribute to overall increased presence of these types of products and help to diversify the homogenised food systems [37,40].

Sensory characteristics of foods, apart from sociocultural factors, are essential in new food product development. Insects are described to have complex sensory profiles which could enhance their usability. For example, earthy, nutty and umami-like flavours are mentioned, but their intensity and presence depend heavily on the type of product, insect species, and preparation techniques applied. Addition of insect flour can influence the texture characteristics of baked products for example, in bread, insect flour decreased the dough porosity and elevated the density and hardness of the product [30,41]. On the other hand, some products have been described to contain off-flavours disincentivising their consumption [42]. Therefore, incorporation of insects and insects derived products in food must account for these impacts. Furthermore, despite the numerous nutritional claims, further studies need to be carried out to confirm the bioavailability [30,43].

Daily per capita consumption of different types of meat in different age and gender groups showed that men tend to consume more meat than women [20,43,44]. Depending on the country, men consumed between 17% (Malaysia) and 58% (Germany) more meat than women [45]. The highest total consumption (225 g/day) was recorded in the male age group 19–30 years [44]. At the same time, young adults were the most prone segment of the population to try new foods, whilst often developing life-long food preferences and habits [46]. This means that young people are most likely to change their eating habits and therefore, this age group requires targeted interventions to harmonise their habits with sustainability goals. Tailored education campaigns can encourage more sustainable food choices and promote greater acceptance of insect-based products in the long term. These could include interactive workshops in schools and universities on sustainable food systems, online campaigns highlighting the nutritional and environmental benefits of eating insects, and the integration of insect-based dishes in cafeterias. Some work has already been carried out, for example, at schools and in university settings where insects have been introduced in cafeterias and other food service establishments. The results of the study by Collins et al. (2019) showed that images without visible insects were favoured and that children's willingness to try insect foods decreased with age [47].

In the recent years, the food industry has launched a relatively higher number of products made using insects, including insect protein isolates and concentrates. Nevertheless, current outcomes suggest that insects cannot yet to be considered a 'normal' food source [48]. Still, insects are highly controversial and are surrounded by many foods

neophobia-like adverse consumer reactions. Policy makers, the food industry and the food service sector should align efforts to sustainably promote consumption of insects.

These examples highlight the diverse and multifaceted nature of entomophagy in public discourse, ranging from personal preferences and cultural attitudes to prominent advocates and significant investments from various stakeholders [39].

The focus of this study was on the Generation Z (GenZ) and Millennials, as they have a high potential for adapting their diet. Those born between 1981 and 1996 are considered Millennials, and those born between 1997 and 2012 are GenZ [49]. The work identified barriers to the consumption of insect-based products, such as neophobia. Using a survey on intention to consume insects and tasting products that insect flour is used, new research was conducted to analyse beliefs and awareness regarding sustainable food consumption and the perception of insects as a source of protein, and to propose recommendations that could be used by food system actors, including the gastronomic landscape.

2. Materials and Methods

This study was based on a mixed methods approach involving a close-ended quantitative questionnaire focussed on the consumption of insect-based products and a sensory tasting of those products to investigate young adults' awareness, perceptions and sensory experiences of insect-based products and to assess potential food neophobia.

2.1. Close-Ended Questionnaire

The questionnaire was designed to evaluate the habits and attitudes regarding sustainable food consumption of the selected population. For its creation, validated questionnaires by Reed et al. (2021) [50], Ros-Baró et al. (2022) [51], Steptoe and Pollard (1995) [52], Hoek et al. (2011) [53] and Mesinger et al. (2023) [54] were identified and used to form a questionnaire to fulfil the requirements of the research project. Following these tools minimised the variability that could result from different interpretations or implementations by participants and ensured consistency. The questionnaire was distributed electronically via the Online-Surveys platform Jisc [55] and through various electronic/online communication channels. The questionnaire consisted of 49 questions presented either as multiple-choice answers or using Likert scales (see Supplementary Material S1).

2.2. Sensory Evaluation

This stage of the project consisted of the sensory evaluation of 10 different food products, 5 were insect-based and 5 were insect-free supermarket brands that matched the products (see Supplementary Material S2). Future studies in this area could consider the sensory evaluation of further products and ingredients, as this market is rapidly evolving.

The testing followed the Central Location testing (CLT) approach, as the panellists were evaluating the product in a central venue, West London Food Innovation Centre at the University of West London, and no samples have been tested outside of the specified location. Each sample has been served with white and odour-less paper plates and utensils. The samples were assigned with three-digit codes for randomisation purposes and have been served at room temperature (see Supplementary Material S2). The panellists have been asked to rinse their mouth with water for pallet cleansing to eliminate the carryover effect. In the testing booths, warm-light was used to re-create dining-like experience. During the tasting, participants were asked to evaluate the products with their eyes open using the 5-Point Hedonic Sensory Evaluation Scorecard by Singh-Ackbarali and Mahara [56]. No further information, such as advantages and disadvantages of the products, were given before and during the tasting in order not to influence the responses.

To minimise the chances of panel fatigue, the test has been designed to take about 15 to 20 min. At any given moment, maximum of four samples were presented, also for the same reason. Furthermore, the tests were being carried out at different days of the week, and during different hours, mainly between 09:00 and 11:00 and 14:00–16:00. Each panellist was present for one session only.

The above methodology followed two ISO standards; BS ISO 8586:2012 "Guidelines for the selection, training and monitoring of selected assessors and expert assessors" and BS ISO 8586:2014 "General Guidelines for the selection, training and monitoring of selected assessors and expert assessors" [56,57].

2.3. Recruitment Strategy

The recruitment strategy was carried out in Summer 2024 and involved recruiting GenZ and Millennials participants at the University of West London, no further criteria were applied, allowing for a more representative population group due to the diverse nature of the recruitment location. Participants were recruited through posters, social media outreach, and direct invitations during university events, ensuring a diverse and broad sample. The use of snowball sampling and voluntary response sampling strategies [58] ensured that as many people as possible received the online questionnaire and were able to participate.

Including outside of the organisation, in total 118 participants, were recruited for the survey. Future studies in this area could consider recruiting more people from within other age groups and at different geographical locations.

The sensory evaluation panel was recruited from the questionnaire population as well as through additional advertising within the university. Each participant has been briefly screened to ensure suitability for the sensory analysis [57]. In total, 59 panellists have been recruited for the sensory evaluation, forming a representative sample for the statistical evaluation.

2.4. Ethics

Ethical approval was provided on behalf of the University of West London Research Ethics Committee in May 2024, with the approval number of 32109453.

2.5. Data Analysis

Statistical analysis of data from the close-ended questionnaires and the sensory analysis have been performed using a one-way Analysis of Variance (ANOVA), Persons Correlation Coefficient, Standard Deviation and for the Descriptive data the Skewness and Kurtosis analyses [59]. Significance was assessed as $p < 0.001$ or $p < 0.05$. The data has been presented in tables and discussed in the following sections. The analysis has been carried out using IBM SPSS v.29 software.

3. Results

3.1. Questionnaire Results

The demographic information of the participants is presented in Table 1. The total number of participants are 118, the age groups were 18–24 (67.8%) and 25–30 (32.2%), with a significant skew towards female participants (66.9% females vs. 33.1% males). Most of the participants are either employed (32.2%) or hold a Master's degree (33.9%), with smaller groups being students and apprentices. The survey was open across the world as it was advertised at social media, however most of the people were from Europe (94.9%) and currently residing there. There are very few participants from other continents, highlighting a strong European focus in the sample.

Table 1. Demographic characteristics of 118 survey participants.

Population Characteristics		Number (N) of Participants
Age	18–24	80
	25–30	38
Sex	Male	39
	Female	79
Occupation	Student	5
	Bachelor	27
	Master	40
	Employed	38
	Other	27
Birth continent	Asia	11
	Europe	106
	Australia	1
Insect eating experience	Yes	22
	No	96
Know about insect products	Yes	97
	No	21
Non-Visible insects in products	Yes	110
	No	8

The data in Table 1 shows a notable discrepancy between awareness and consumption of insect-based products among participants: 82.2% are aware of such products, but only 18.6% have consumed them. This discrepancy has already been noted in other publications and indicates barriers to acceptance [32,60]. In addition, a preference for insect-based products is strongly influenced by their appearance, with 93.2% of participants finding these products more appealing when the natural appearance of the insects is hidden [33]. These results underline the importance of product formulations and marketing strategies that minimise the visibility of insects to improve consumer acceptance and potentially increase the consumption of insect-based foods.

Descriptive statistics, using Skewness and Kurtosis (see Table 2), were applied to identify whether the parameters tested followed a normal or skewed distribution. All parameters followed a normal distribution (with exception of preference), as skewness and Kurtosis were between −2 and 2. As the data was normally distributed, the Pearson test (see Table 3) and not the Spearman correlation test was applied to predict behaviour trends.

Participants with high general neophobia scores (see Table 3) show significant positive correlations with perceiving insects as unsafe to eat ($r = 0.379$, $p < 0.001$) and feelings of disgust ($r = 0.368$, $p < 0.001$), while they are negatively correlated with the willingness to consume insect-based products in the future ($r = -0.208$, $p < 0.05$). However, general neophobia does not significantly correlate with perceptions of insects' nutritional benefits ($r = -0.058$, $p = 0.535$) or environmental impact ($r = -0.043$, $p = 0.645$).

Similarly, high food neophobia scores (see Table 3) are significantly correlated with stronger perceptions that insects are unsafe to eat ($r = -0.418$, $p < 0.001$) and feelings of disgust ($r = -0.505$, $p < 0.001$). Food neophobia is also negatively correlated with the willingness to consume insects in the future ($r = 0.339$, $p < 0.001$). Food neophobia has

a modest positive correlation with perceptions of insects' nutritional value (r = 0.275, $p < 0.01$) and environmental impact (r = 0.266, $p < 0.01$).

Table 2. Descriptive statistics on parameters tested, following normal distribution.

	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
Participant number	34.208	0.000	0.223	−1.200	0.442
Age	0.469	0.772	0.223	−1.429	0.442
Gender	0.472	−0.730	0.223	−1.493	0.442
Occupation	1.101	−0.693	0.223	0.663	0.442
Affordability insect products	0.384	1.706	0.223	0.925	0.442
Peers that eat insects	0.391	−1.631	0.223	0.671	0.442
Preference	0.252	3.483	0.223	10.305	0.442
Average general neophobia	0.733	0.025	0.223	−0.669	0.442
Average score food neophobia	0.593	0.326	0.223	−0.269	0.442
Intension to eat	0.788	1.009	0.223	1.637	0.442
Religion	0.964	1.273	0.223	1.541	0.442
Purchase (5, 6,7) *	0.878	0.314	0.223	−0.315	0.442
Friend to eat (8, 9) *	0.947	0.291	0.223	−0.071	0.442
Safe average (10, 19) *	0.731	−0.587	0.224	1.106	0.444
Intend to consume (11, 12, 13) *	0.707	0.443	0.223	0.656	0.442
Disgust (14, 18) *	0.861	−0.638	0.223	0.318	0.442
Nutrition (15, 16, 20, 21) *	0.608	0.550	0.224	0.951	0.444
Environment (22, 17) *	0.859	0.111	0.223	−0.006	0.442
Future trends (25, 26, 27) *	0.702	0.393	0.224	−0.043	0.444

where *; the full questions are presented in Table 5.

Table 3. Pearson correlation between average general neophobia and average food neophobia.

		Friend to Eat	Safe Average	Future to Consume	Disgust	Nutrition	Environment	Future Trends
Average general neophobia	Correlation Coefficient	−0.183 *	0.379 **	−0.208 *	0.368 **	−0.058	−0.043	−0.168
	Sig. (2-tailed)	0.047	0.000	0.024	0.000	0.535	0.645	0.071
	N	118	117	118	118	117	118	117
Average score food neophobia	Correlation Coefficient	0.317 **	−0.418 **	0.339 **	−0.505 **	0.275 **	0.266 **	0.297 **
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.003	0.004	0.001
	N	118	117	118	118	117	118	117

* Significant different $p < 0.001$. ** Significant difference $p < 0.05$.

These findings underscore that while neophobia strongly influences willingness to consume insect-based foods, emphasizing nutritional and environmental benefits alone may not be sufficient to overcome the aversion.

Participants who have already consumed insects (see Table 4) are more likely to buy insect-based products (r = 0.296; $p = 0.001$) and show a positive correlation with their future intention to consume those products (r = 0.312; $p = 0.001$). While these participants show a correlation with the intention to eat these products due to the positive impact on nutrition

(r = 0.282; p = 0.002) and the environment (r = 0.286, p = 0.002), it does not significantly influence perception of safety (r = −0.082, p = 0.380) Moreover, participants with prior insect consumption experience are less likely to report disgust (r = −232, p = 0.011), which may contribute to their openness towards insect-based products.

Table 4. Pearson correlation between participants that had experience eating insects.

		Intension to Eat	Purchase	Friend to Eat	Safe Average	Future to Consume	Disgust	Nutrition	Environment	Future Trends
Participants Eaten insects	Pearson Correlation	0.226 *	0.296 **	0.334 **	−0.082	0.312 **	−0.232	0.282 **	0.286 **	0.288 **
	Sig. (2-tailed)	0.014	0.001	0.000	0.380	0.001	0.011	0.002	0.002	0.002
	N	118	118	118	117	118	118	117	118	117

* Significant different $p < 0.001$. ** Significant difference $p < 0.05$.

These results suggest that personal experience with insect consumption can play a crucial role in reducing feelings of disgust and enhancing acceptance of insect-based products, particularly when nutritional and environmental benefits are emphasized.

The results of the questionnaire by Reed et al. [50] (see Table 5) show contextual and social influence on the willingness to consume insect-based products. People are more willing to eat insects if the products are more affordable and available on the local market. For example, 67% of respondents stated that they would be more willing to try insect-based products if they were in a region where this was more common (Q1), and 47% stated that they would be influenced to eat these products if their friends or family did so (Q8). This suggests that social and cultural normalisation could significantly influence acceptance [61,62]. Moreover, respondents show strong agreement on the potential benefits of insect consumption. Most recognise insects as a good source of protein and other nutrients (86%) (Q15), and many believe that eating insect-based products promotes environmental sustainability (58%) (Q17) and is a healthy choice (38%) (Q20). These advantages were also confirmed by the literature research [16,20,60,61]. Despite these perceived benefits, personal enjoyment and familiarity with insect-based products lag, with only 14% finding them enjoyable (Q13) and 8% familiar (Q12). This indicates a gap between recognising the benefits and personal readiness to adopt such a diet.

The results of those statements that reflect negative attitude toward trying insect-based product (see Table 5, questions 2., 3., 4., 9., 10., 14., 18., 19. and 24.) illustrate a differentiated view that is influenced by various factors. A significant proportion of respondents do not see any concerns regarding the safety and health effects of eating insect-based products. A substantial proportion of respondents express significant apprehension regarding the safety and health implications of eating insect-based products. Specifically, 69% of participants disagree with the notion that consuming these products is dangerous (Q10), and 55% rebut the idea that such products are unsanitary (Q24). Similarly, 77% of respondents dismiss the fear that these foods could cause physical illness (Q14). These results and views of respondents could be enhanced in the future as various official bodies work to remove regulatory barriers and to create comprehensive genetic databases for insects [17,38,63–65]. Additionally, 61% of respondents view the consumption of insect-based products as adventurous (Q2), indicating some openness to the novelty. Social and religious factors complicate the acceptance of insect-based diets [66]. While only 28% believe that eating such products would impress friends and family (Q9), suggesting a low social reward, 7% cite religious beliefs as a deterrent, emphasising a role of cultural norms in dietary choices (Q3) [50].

Table 5. Participant response in relation to the willingness to consume insect-based products [51] for GenZ and Millennials.

Question	Agree (%)	Neutral (%)	Disagree (%)
1. I would be more likely to try eating insect-based products if I were in a region in which it is more common.	67	17	16
2. Eating insect-based products is adventurous.	61	24	15
3. Religious beliefs deter me from eating insect-based products.	7	4	89
4. Moral beliefs deter me from eating insect-based products.	21	17	62
5. I would purchase insect-based products to eat.	36	27	38
6. If insect-based products were available at my local market, I would be more likely to purchase them to eat.	51	18	31
7. Insect-based products should be more affordable than other animal-based products.	44	44	12
8. If my friends or family were eating insect-based products, I would eat them too.	47	25	29
9. Eating insect-based products will impress my friends and family.	28	31	42
10. Eating insect-based products is dangerous.	4	27	69
11. I think that the consumption of insect-based products might become a common practice in the future.	67	23	10
12. Eating insect-based products feels familiar to me.	8	21	71
13. Eating insect-based products is enjoyable.	14	53	33
14. I'm afraid eating insect-based products will make me physically ill.	10	13	77
15. Insects are a good source of protein and other nutrients.	86	12	2
16. Insects are a good alternative to eating beef.	45	31	25
17. Eating insect-based products promotes environmental sustainability.	58	34	8
18. Eating insect-based products is disgusting.	21	33	47
19. It is not safe to eat insect-based products.	5	28	67
20. Eating insect-based products is healthy.	38	60	2
21. Eating insect-based products add variety to the diet.	62	28	9
22. Insects are generally the solution to feeding the world.	30	42	29
23. Eating insect-based products is the newest trend.	39	30	32
24. Eating insect-based products is unsanitary.	7	38	55
25. I want to include insect-based products in my usual diet.	21	33	47
26. I think that insect-based products would be welcomed by the general public.	24	21	55
27. Knowing that the consumption of insect-based products has the potential to be a sustainable food practice would encourage me to consume them.	58	23	18
28. I would be more likely to try eating insect-based products if I were in a region in which it is more common.	67	17	16

While awareness of the nutritional and environmental benefits of insect-based products exists, significant barriers to personal enjoyment, familiarity and cultural acceptance remain. To close this gap, publications recommend creating more familiarity through education and nudging as well as a gradual introduction to familiar products, which can improve acceptance and integration into the daily diet. Efforts must also focus on overcoming cultural and religious sensitivities [33].

3.2. Sensory Evaluation Results

The sensory evaluation study included 59 participants, with a diverse demographic profile in terms of age, sex, and education level. The demographic overview highlights a young, well-educated participant pool with a balanced representation of sexes among those who disclosed this information. This variety in demographics provides a comprehensive base for sensory evaluation, ensuring diverse perspectives and experiences. The demographics of the participants align with other literature indicating that younger and more educated individuals are generally more open to trying novel foods, including insect-based products [50,67]. To improve demographic representation for a more comprehensive sensory evaluation in the future, it would be important to include more participants in general, but especially more participants with lower levels of formal education.

The participants identified significant differences in appearance and sweetness of the granola, while the rest of the characteristics tested (aroma, taste, and mouthfeel) showed no significant differences (see Table 6).

Table 6. Evaluation results using score with standard deviation (STD) of commercially available foods using insects-based products and the standard supermarket brand products. 59 participants rated appearance, aroma, taste, sweetness and mouthfeel.

Products	Appearance Score	Aroma Score	Taste Score	Sweetness Score	Mouthfeel Score
Granola	1.7 ± 0.1 *	2.3 ± 0.1	1.7 ± 0.1	1.6 * ± 0.1	1.9 ± 0.1
Granola with insects	2.2 ± 0.1 *	2.1 ± 0.1	2.0 ± 0.1	2.2 * ± 0.1	2.1 ± 0.1
Chocolate bar	2.0. ± 0.3	2.2 ± 0.1	2.3 ± 0.2	2.3 ± 0.2	2.2 ± 0.2 **
Chocolate bar with insects	2.2 ± 0.1	2.2 ± 0.2	2.7 ± 0.2	2.8 ± 0.2	2.7 ± 0.2
Berry bar	2.0 ± 0.1	1.8 ± 0.1	2.1 ± 0.2	2.0 ± 0.2	2.0 ± 0.2
Berry bar with insects	2.0 ± 0.1	1.9 ± 0.1	2.3 ± 0.2	2.2 ± 0.2	2.2 ± 0.2
Hazelnut spread	1.6 ± 0.1 *	2.0 ± 0.1 *	1.7 ± 0.1 *	1.8 ± 0.1 *	1.6 ± 0.1 *
Hazelnut spread with insects	2.6 ± 0.1 *	2.7 ± 0.1 *	2.9 ± 0.1 *	2.8 ± 0.2 *	2.7 ± 0.2 *
Puffs	1.9 ± 0.1 *	2.7 ± 0.2 *	1.9 ± 0.1	2.5 ± 0.1	1.9 ± 0.2
Puffs with insects	2.7 ± 0.1 *	2.1 ± 0.1 *	1.9 ± 0.1	2.6 ± 0.1	1.9 ± 0.1

* Significant different $p < 0.001$. ** Significant difference $p < 0.05$.

There were no significant differences between the two chocolate bars, except for the mouthfeel, where the participants significantly preferred the standard product (2.2 ± 0.2) compared to the insect-based version (2.7 ± 0.2). Overall, the traditional chocolate bar was preferred, but both bars scored highly in appearance, indicating a visual appeal that resonated well with participants. This preference aligns with findings that traditional and familiar flavours often overshadow novel ones [33,61,62] (see Table 6).

No significant differences between the two berry bars. This indicates that the participants did not perceive any significant difference in terms of appearance, aroma, taste, sweetness or mouthfeel between the standard and insect-based versions (see Table 6).

For the hazelnut spread, significant differences were found across all criteria, with participants consistently preferring the insect-free version. Among the evaluated aspects, the category appearance received the best average rating for the insect-based spread (2.6 ± 0.1). In contrast, the traditional hazelnut spread excelled in the category mouthfeel (1.6 ± 0.1 vs. 2.7 ± 0.2). These results indicate that, while the appearance of the insect-based spread was appreciated, the traditional spread was favoured for its superior mouthfeel, contributing significantly to its overall higher preference among participants. This reflects existing literature that indicates strong consumer loyalty to familiar taste and tex-

ture profiles, particularly in indulgent products like hazelnut spread [61,62]. The lower acceptance of the insect-based spread underscores the challenge of competing with well-established products in terms of sensory attributes (see Table 6).

Regarding the Puffs, significant differences were found in the appearance and aroma criteria. The insect-based puffs scored significantly higher in appearance (2.7 ± 0.1) compared to the standard puffs (1.9 ± 0.1). However, the standard version outperformed the insect-based puffs in aroma (2.7 ± 0.2 vs. 2.1 ± 0.1). These results indicate that while participants appreciated the visual aspect of the insect-based puffs, other sensory attributes were perceived as similar between the two products (see Table 6).

4. Discussion

The study examined attitudes of GenZ and Millennials towards sustainable food consumption, with a focus on insect-based products. This demographic has the highest overall consumption of animal-based proteins, with rates forecasted to continue to rise [20,44]. Despite the growing awareness of the environmental and health impacts of high meat consumption, such as the significant contribution to greenhouse gas emissions [22,68] and the increased likelihood of chronic diseases including type 2 diabetes, cardiovascular diseases, dementia, and various types of cancers [14,22], this group continues to consume almost twice the recommended amount of protein for a balanced diet [14,20].

The paradox between high awareness of GenZ and Millennials regarding the benefits of sustainable diets and low acceptance of insect-based products was a key finding of this study. While 93% of young adults are advocating an environmentally friendly diet, their actual consumption behaviour reflects a continued preference for meat, resulting in a 32% increase in meat sales [69]. This highlights a gap between ideals and action, suggesting that advocacy for sustainability does not necessarily translate into sustainable eating habits. Although 97% of respondents are aware of insect-based products and their benefits, with a significant majority recognising insects as a viable source of protein (86%) and acknowledging their potential to contribute to environmental sustainability (58%), the actual willingness to buy and consume these products remains low at 18.6% [70], indicating that awareness alone is insufficient to overcome deeply rooted barriers

Similarly to previous findings [33,61], a considerable portion of respondents are cautious about unfamiliar foods and varying degrees of neophobia are identified, with many participants exhibiting apprehension toward new foods. The acceptance of insects as a protein source remains limited compared to plant-based alternatives. Insects are the least accepted alternative, with significant scepticism regarding their taste, texture, and overall culinary versatility [71,72]. This makes it challenging to gain wider acceptance for insect-based products.

However, there is significant evidence that participants who had already consumed insects in the past are also willing to buy insect-based products in the future. This correlates with the intention to eat these products due to the positive effects on nutrition and the environment. This indicates that the first contact with such foods, preferably at a young age, plays a decisive role in breaking down psychological barriers.

The obtained results reflect a broader challenge of changing dietary habits in response to environmental concerns. The low acceptance of insect proteins in Western cultures, despite their high nutritional value and ecological benefits, align with prior research [1,33,61]. For instance, cultural and religious beliefs, cited by 7% of participants as barriers to consumption, further underline the persistent cultural resistance to adopting insect-based products. Additionally, the phenomenon of 'nostalgia' appears to drive preferences for traditional, familiar products such as a classic chocolate spread, reflecting a psychological comfort associated with well-known products.

The sensory evaluation provided valuable insights into overcoming barriers. Blind tasting removed the visual 'disgust' factor, allowing participants to evaluate the flavour and other characteristics unbiased. Products such as the berry bar, granola, and chocolate bar containing insects were rated similarly to their traditional counterparts. This demonstrates the potential for marketing strategies that focus on integrating insect proteins into familiar formats while minimising the visual presence of insects [61]. Furthermore, existing studies suggest that the general population might initially resist insect-based products, while those who are more health-conscious or interested in sustainable food sources might be more receptive [29,73,74].

4.1. Framework for Introducing Insect-Based Products

Based on the findings, an introduction of insect-based products in Western Markets could be as followed:

1. Education and Awareness Campaigns: Developing targeted educational content emphasising the nutritional and environmental benefits of insect proteins (e.g., online video demonstrating how insect flour is produced and showing its nutrient content) [47].
2. Integration into Familiar Foods: Introducing insect proteins in familiar products where the visual presence of insects is minimised (e.g., cricket powder added to popular energy bars) [61,62,75].
3. Sensory Enhancement: Focusing on improving sensory properties to meet consumer expectations (e.g., incorporating honey to complement the 'earthy' taste of insect protein in granola) [76].
4. Blind Tasting Events: Organising tastings where consumers can experience insect-based products without visual bias, helping to build positive associations (e.g., tasting booths at food festivals) [77].
5. Collaboration with Chefs: Partnering with chefs to create high-quality dishes that incorporate insect proteins seamlessly into traditional culinary traditions (e.g., developing a 'cricket Bolognese', showcased in a cooking show) [13].
6. Regulatory Support: Advocating for clear regulations on insect protection and processing standards to build consumer trust (e.g., guidelines similar to those from organic labelling) [8,18,78].
7. Insights from Culturally Accepted Regions: In regions such as Southeast Asia, the consumption of insects is normalised and marketed as a delicacy (e.g., launching marketing campaigns with positive connotations) [79].

4.2. Strengths and Limitations

A strength of this study is the focus on the GenZ and Millennial demographic, which plays a crucial role in shaping future food trends, as eating habits are most likely to change at a young age. The inclusion of sensory evaluations and a survey provided valuable insights to better understand and overcome barriers to acceptance. The study also shows limitations in terms of depth and scope. A majority of female participants took part in the survey, which shows an unequal gender distribution. However, according to Okumus et al. (2021) [80], young consumers (GenZ) do not show greater differences between the different genders in terms of neophobia towards food than previous generations. In the case of this study's sample, the potential differences are therefore negligible at this stage, although this area requires further research in the future. Future studies should also focus on generally broadening the diversity of participants, considering and improving the sensory characteristics of more products, confirming the bioavailability of insects, and making

deeper comparisons with regions where insect consumption is culturally normalised to promote wider acceptance of insect consumption in Western regions in the future.

5. Conclusions

In summary, this study provides valuable insights into the awareness, beliefs, and acceptance of insect-based products among GenZ and Millennials, predominantly European participants. Whilst there is awareness of the environmental and health benefits, actual consumption remains limited, with significant barriers such as neophobia and unfamiliarity influencing uptake. This discrepancy illustrates that promoting sustainable changes in diet, particularly in relation to cultural norms, sensory preferences and eating habits, is a major challenge. However, sensory evaluations showed potential for insect-based products, particularly in categories where flavour and texture meet consumer expectations. Although traditional products received better ratings, there is clear interest in the environmental and nutritional benefits of insect-based alternatives. Closing the gap between awareness and behaviour requires a multi-faceted approach that includes education, innovation, and political support. This will involve a gradual introduction of insect-based products in familiar forms to encourage wider acceptance across the food systems.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/gastronomy3010002/s1, S1: Close-ended questionnaire used for the study; S2: Insect-based and comparison products including randomly assigned numbers used for the sensory evaluation.

Author Contributions: Conceptualization, M.W., A.T. and S.W.L.; methodology, M.W., A.T. and S.W.L.; software, M.W. and A.T.; validation, M.W. and A.T.; formal analysis, M.W. and A.T.; investigation, M.W., A.T. and S.W.L.; resources, M.W., A.T. and S.W.L.; data curation: M.W. and A.T.; writing-review and editing, M.W., A.T. and S.W.L.; visualization, M.W., A.T. and S.W.L.; supervision, A.T.; project administration, M.W. and S.W.L.; funding acquisition, M.W., A.T. and S.W.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the University of West London Research Ethics Committee (protocol code 32109453, approved in May 2024).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All data is available within the article. Raw data could be shared on a one-to-one request basis.

Acknowledgments: The authors acknowledge the input from colleagues and thesis supervisors received throughout the manuscript preparation. The authors also acknowledge the access to the laboratory facilities granted on behalf of the West London Food Innovation Centre.

Conflicts of Interest: The authors declare that there are no known competing financial interests or personal relationships between the authors and the authors of the articles included in the review and the institutions that could have appeared to influence the work reported in this paper.

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