

Consumer Perceptions and Acceptance of Alternative Proteins: Demographic Insights from a Mediterranean Context

ANNAH MALLIA^{a,*} AND PETRA JONES^a

^aDepartment of Food Science, Nutrition and Dietetics, Faculty of Health Sciences, University of Malta, Msida, Malta

*Corresponding author

annahmallia237@gmail.com

TEL: +356 79379674

Received: 17 October 2025 ; Published online: 6 October 2026

Abstract

Alternative Proteins (APs) encompass various sustainable protein sources, including plant-based proteins, edible insects, and cultured meat, serving as substitutes for traditional animal-based options. As the global food system evolves to meet the demands of a growing population, understanding consumer perceptions is key to fostering dietary shifts.

This study assessed consumer knowledge, awareness, and willingness to consume APs. An anonymous online survey was used for data collection in a cross-sectional study targeting consumers aged 16 to 80 years living in Malta. Ethical approval was obtained, and participants (N=479) were conveniently recruited through social media pages. Associations between demographic variables and perceptions of AP were analysed using the Chi-squared test.

Participants were predominantly female, aged 35-45 years, non-smokers, and well-educated. Participants were significantly more likely to understand the term 'edible insects' if they were younger ($p=0.033$) and male ($p=0.004$), while younger and highly educated individuals were more likely to perceive all APs as safe for consumption ($p=0.001$). The top motivators for trying APs were environmental sustainability (50.1%), health benefits (40.4%), and animal welfare (29%). Among APs, plant-based proteins were the most accepted, followed by cultured meat and edible insects.

These findings highlight key demographic differences in consumer perceptions of APs and underscore the importance of addressing both knowledge gaps and motivational factors. Understanding the drivers and barriers influencing acceptance can inform strategies to encourage the adoption of sustainable dietary practices and support the integration of APs into mainstream food consumption, particularly within Mediterranean contexts.

Keywords: Plant-based proteins; edible insects; cultured meat; consumer awareness; dietary behaviour.

1 Introduction

By 2050, the global food system must support over 10 billion people, who will likely have higher incomes and demand more diverse, affluent diets (FAO et al., 2020). To meet this challenge, food production must prioritise sustainability to address climate change and environmental issues

(Garcia et al., 2020). Given the significant impact of diet on human health, promoting healthier eating habits is also crucial for individual well-being and reducing healthcare costs. However, the current food system is not on track to achieve these goals.

One promising solution lies in APs, defined as unconventional, high-protein food sources de-

signed to offer sustainable and nutritious alternatives to conventional, animal-based products (European Food Safety Authority, 2023). APs offer sustainable sources of nutrition that can mitigate the environmental impact of traditional livestock farming while potentially meeting the dietary preferences of a growing global population. APs are gaining popularity not only among those on plant-centric diets but also among meat consumers seeking to reduce their intake (Stubelj et al., 2025). The shift is vital given the resource-intensive nature of traditional animal protein production and the increasing global demand for meat. Concerns over food sustainability, safety, security, nutrition, and animal welfare further fuel driving the transition to these alternatives. Traditionally, European diets have relied heavily on meat, fish, and dairy, food often produced through intensive farming practices that contribute significantly to environmental degradation (European Environment Agency, 2018). Nevertheless, while APs have a role in shaping future food choices and advancing sustainability efforts globally (Kareem et al., 2025), the growth and consumer intake of AP remains limited (Malila et al., 2024).

As awareness of APs grows, consumers' choices influence demand and contribute to shaping more sustainable food systems. However, acceptance remains limited, particularly for cultured meat and edible insects (Kareem et al., 2025; Onwezen et al., 2021). In Europe, reluctance to try insects is a significant barrier, in contrast to some Asian countries where such foods are culturally accepted (Mina et al., 2023). Consumers play a pivotal role in this dietary transition, as shifts in consumption behaviours are essential to achieving both global sustainability goals and individual health benefits. Acceptance of APs can be fostered by first raising awareness and stimulating curiosity, then providing knowledge about the innovation process and its advantages. This combined approach has the potential to enhance consumer confidence and increase the likelihood of AP adoption in purchasing decisions (Pakseresht et al., 2022). A systematic review by Hartmann and Siegrist (2017) found that consumers across Western countries, including Germany, the Netherlands, and Portugal, seem unaware of the significant environmental impact of

meat production and consumption. In a related paper, Boatey et al. (2025) noted that the promotion of cultured meat has predominantly focused on its broader sustainability benefits, including the elimination of animal slaughter, lower greenhouse gas emissions, and reduced reliance on antibiotics. Cordts et al. (2014) further highlighted gender differences, reporting that women were generally more knowledgeable about APs and more inclined to reduce meat intake. Evidence suggests that providing targeted information can significantly influence consumer acceptance of APs. Pakseresht et al. (2022) found that willingness to try cultured meat increased when participants received not only basic product descriptions but also supplementary details highlighting its environmental advantages over conventional meat. Similarly, Amoneit et al. (2025) reported that environmental consciousness was a key driver of willingness to purchase such products. Collectively these findings suggest that educational strategies emphasising the environmental implications of dietary choices can enhance both trial and purchase intentions for APs.

Among the APs, consumers tend to be more familiar with plant-based proteins, likely due to their wider availability compared to emerging options like edible insects and cultured meat. However, a lack of knowledge of APs remains a barrier to informed purchasing decisions. Studies have shown that even brief educational interventions such as providing an overview of AP types and their benefits can improve understanding and increase consumers' willingness to try them (Hartmann & Siegrist, 2017, 2018). Across the Mediterranean region, plant-based protein products are becoming more visible in supermarkets, yet public awareness and dietary guidance encouraging a shift from animal-based to plant-based products remain limited. Despite the well-documented health and sustainability benefits of the Mediterranean dietary pattern, adherence is declining in several countries (Damigou et al., 2023) as globalised food systems increasingly shape consumer choices. This trend reflects a broader regional challenge, where changing diets are not matched by consistent policy support or consumer education initiatives (Berry, 2019; Capone et al., 2021).

Within this regional context, Malta provides

a pertinent case study. The country has experienced similar declines in adherence to the Mediterranean diet (Cuschieri & Libra, 2021; Treki & Jones, 2021), alongside greater availability of plant-based products but minimal guidance for consumers on their integration into daily diets. This erosion of traditional dietary patterns is compounded by a lack of national data on meat consumption and related behaviours, limiting the ability to track shifts toward or away from sustainability-oriented eating. This study examined consumer perceptions of AP sources by assessing awareness, knowledge, safety perceptions, and willingness to consume them. It also explored how demographic factors influence acceptance, with the aim of contributing to the broader Mediterranean discourse on sustainable dietary transitions. While five primary APs are currently under development in Europe, as summarised in Table 1 (EIT Food, 2022), this research focused on plant-based proteins, edible insects, and cultured meat, representing both widely discussed alternatives and those gaining visibility in the European market.

2 Materials and Methods

Ethical approval for this study was obtained from the Faculty Research Ethics Committee at the Faculty of Health Sciences, University of Malta (Reference Code: FHS-2023-00425). An information letter was also included at the start of the questionnaire to outline details of the study whilst completion of the questionnaire was taken to imply consent.

The surveys were distributed through various social media pages including the University of Malta mailing list, institutional networks and food related websites. Data was collected in Malta through a cross-sectional online survey conducted from October 2023 to January 2024. The data collection tool was a questionnaire adapted from an established 2022 study commissioned by the UK Food Standards Agency (FSA) (Jarchlo & King, 2022). Items were reviewed for clarity and contextual relevance to the Maltese context prior to dissemination. As the survey primarily utilised single-item measures, internal consistency reliability testing was not ap-

plicable. While a demographic section was incorporated into the questionnaire, no modifications were made to the original FSA instrument. The questionnaire was reviewed for cultural relevance to the Maltese context by two independent nutrition researchers and a small group of lay volunteers, who assessed clarity of wording, appropriateness of terminology, and relevance to local food practices. The survey comprised two sections: Section A collected demographic information using closed-ended multiple-choice questions while Section B included inquiries aimed at assessing participants' understanding, safety perceptions, willingness to try, reluctance to consume, and motivations regarding the three types of APs. Additionally, Section B analysed participants' openness to consuming edible insects in different food forms.

Inclusion criteria required participants to be aged 16 or older and residing in Malta. Recruitment was conducted via an online survey platform, where individuals were invited to participate voluntarily. Data collection relied on a convenience sampling method, with the questionnaire distributed mainly through social media platforms, university mailing lists and professional networks. Based on National Statistics Office (2023) population data, a sample size of 385 was calculated to achieve a $\pm 5\%$ margin of error. At the start of the survey, participants could select their preferred language. Translations were carried out by a qualified translator to ensure accuracy and prevent data loss. Incomplete or missing responses were excluded from the final dataset. The collected data were then cleaned by categorising responses and assigning numerical codes, facilitating quantitative analysis. Visual representations of the data including descriptive statistics and graphical summaries were created, and the compiled data was organized in Excel before being imported into the Statistical Package for the Social Sciences (SPSS Statistics 30). Descriptive statistics were used to summarise the study variables. Pearson chi-squared tests were conducted to examine associations between categorical variables, including age, gender, and educational level, and respondents' perceptions of alternative proteins (APs), such as knowledge, perceived safety, and willingness to try. Subsequently, regression modelling

Table 1: Overview of five primary alternative protein sources under development in Europe (EIT Food, 2022; European Food Safety Authority, 2023; Joshi & Kumar, 2015; Smetana et al., 2015).

AP Category	Description	Examples
Plant proteins	Proteins derived from plant sources including legumes, cereals, oilseeds, nuts, and pseudo-cereals. These proteins are commonly processed into meat and dairy analogues due to their functional properties such as gelation, emulsification, and water-binding capacity.	Soy-based products (tofu, tempeh, textured vegetable protein), pea protein isolates used in plant-based burgers, wheat gluten (seitan), oat or almond dairy alternatives.
Edible insects	Insects that are consumed either whole or processed into ingredients such as powders and protein isolates. They are considered highly efficient protein sources with favourable feed conversion ratios and relatively low environmental impact compared with conventional livestock.	Whole crickets or mealworms, cricket flour incorporated into bread, pasta, protein bars, insect-based burger patties.
Cultivated (lab-grown) meat	Meat produced by culturing animal muscle cells in vitro under controlled conditions using cell culture techniques. The process involves cell proliferation and differentiation to create muscle tissue without raising or slaughtering animals.	Cultivated beef burgers, cultured chicken fillets or nuggets, cultivated beef meatballs.
Algal-based proteins	Proteins derived from microalgae or macroalgae (seaweed). Microalgae are rich in protein, essential amino acids, vitamins, and bioactive compounds, and can be cultivated with relatively low land and freshwater requirements.	Spirulina powder, chlorella supplements, seaweed-based ingredients used in snacks, protein powders, and meat analogues.
Fermentation-derived proteins	Proteins produced using microbial fermentation processes, including traditional biomass fermentation and precision fermentation. Microorganisms such as fungi, yeast, or bacteria produce high-protein biomass or specific functional proteins used as food ingredients.	Mycoprotein products (e.g., Quorn™), precision-fermented dairy proteins such as casein and whey alternatives, microbial protein ingredients used in meat substitutes.

was applied to assess the independent effects of age, gender, and educational level on perceived safety of the three APs. Ordinal logistic regression with proportional odds was used where the proportional odds assumption was met, as assessed by the test of parallel lines. Where this assumption was violated, multinomial logistic regression was applied. Statistical significance was set at $p < 0.05$.

3 Results and Discussion

A total of 479 participants completed the survey. Table 2 presents participant demographic

and lifestyle characteristics. The sample was predominantly female, with a high proportion holding post-secondary education and reporting no specific dietary pattern. Most participants were non-smokers and had a BMI in the overweight range.

The associations between demographic factors and familiarity with AP terms are described in Figure 1. In contrast, dietary pattern and BMI were not significantly associated with AP knowledge ($p > 0.05$ across all terms). Providing definitions and images during the survey helped clarify understanding, consistent with findings that basic education increases acceptance of AP

Table 2: Demographic and lifestyle characteristics of the study participants.

Variable		Total
Observations (N*)		479
Age (years)	Mean, 95% CI	41.86, (40.63, 43.09)
Gender	Male N (%)	155 (32.4)
	Female N (%)	321 (67.0)
BMI (kg/m²)	Mean, 95% CI	26.60, (25.96, 27.94)
Education level	Secondary N (%)	24 (5.0)
	Post-secondary N (%)	451 (94.2)
Smoking status	Smokers N (%)	56 (11.7)
	Non-smokers N (%)	418 (87.3)
Nationality	Maltese N (%)	445 (93.0)
	Foreigners in Malta N (%)	32 (6.7)
Dietary pattern	No specific diet N (%)	364 (76.0)
	Mediterranean N (%)	17 (3.5)
	High Protein N (%)	10 (2.1)
	Vegetarian/Vegan N (%)	20 (4.2)

*BMI, body mass index; *N is referred to as the number of observations.*

(Hartmann & Siegrist, 2017; Pakseresht et al., 2022). Acceptance in the present study was generally lower compared with findings reported in other EU countries. This difference may partly reflect variations in market exposure, as consumers in larger European markets are often presented with a wider variety of AP products. In contrast, the Maltese market currently offers a more limited selection of such products, which may reduce consumer familiarity and consequently influence acceptance.

Perceived safety of APs is summarised in Figure 2. Plant proteins were most frequently rated as safe, with responses significantly associated with education level ($p = 0.016$), but not with age, gender, BMI, or dietary pattern ($p > 0.05$). Safety perceptions of edible insects varied significantly by gender ($p < 0.001$) and education ($p < 0.001$), while no significant associations were observed with age, BMI, or dietary pattern. For cultured meat, gender was the only demographic variable significantly associated with perceived safety ($p = 0.025$). Overall, plant proteins were consistently viewed as the safest option, edible insects elicited more polarized responses, and cultured meat was generally perceived as least safe, generating uncertainty across groups. These concerns may reflect limited public understanding of AP production, nutritional

properties, and potential allergens (Castro & Chambers, 2019).

Ordinal logistic regression analyses were conducted to assess the independent effects of age, gender, and education level on perceived safety of the APs (Table 3). The proportional odds assumption was evaluated using the test of parallel lines prior to model estimation. For plant-based proteins, the proportional odds assumption was violated ($\chi^2(15) = 30.159$, $p = 0.011$). A multinomial logistic regression model was therefore considered; however, estimation issues occurred due to sparse responses in the unsafe categories, preventing reliable model estimation.

For edible insects, the proportional odds assumption was satisfied ($\chi^2(15) = 18.894$, $p = 0.219$). Gender, education level, and age were all significantly associated with perceived safety. Younger respondents were more likely to perceive edible insects as safe than those aged over 45 years, while female respondents and those with secondary or post-secondary education had lower odds of perceiving them as safe compared with males and respondents with tertiary education.

For lab-grown meat, the proportional odds assumption was also met ($\chi^2(15) = 19.503$, $p = 0.192$). Gender and education level were significantly associated with perceived safety, whereas age was not. Female respondents and those with

	Age			Gender		Education		BMI			Dietary patterns		
	<25	25-44	>45	Male	Female	Secondary	Post secondary	<18.5	18.5–24.9	25–29.9	No specific diet	MD/ HPD *	Vegetarian /Vegan
Have you ever heard of plant proteins?													
Yes, and I know what it means	60	160	145	119	245	13	349	17	131	199	272	22	20
Yes, but I don't know what it means	7	33	38	22	56	7	71	2	28	44	60	4	0
No	4	11	20	14	20	4	31	0	11	23	32	1	0
P - value (X2) < 0.05	0.136			0.401		0.016		0.547			0.360		
Have you ever heard of edible insects?													
Yes, and I know what it means	53	126	119	106	190	7	289	12	113	162	225	12	18
Yes, but I don't know what it means	11	23	31	26	39	7	58	0	18	42	50	6	1
No	7	55	52	23	91	10	103	7	39	61	89	9	1
P - value (X2) < 0.05	0.033			0.004		<0.001		0.150			0.050		
Have you ever heard of lab-grown meat?													
Yes, and I know what it means	50	115	95	102	157	9	249	12	92	145	194	11	18
Yes, but I don't know what it means	14	45	49	30	77	5	102	3	34	64	88	4	2
No	7	43	59	22	8	10	99	4	43	37	82	12	0
P - value (X2) < 0.05	0.005			0.189		<0.001		0.717			0.005		

Figure 1: Overview of the associations between demographic factors and familiarity with AP terms. MD – Mediterranean Diet, HPD – High Protein Diet.

post-secondary education had lower odds of perceiving lab-grown meat as safe compared with males and respondents with tertiary education. Overall, the results suggest that gender and education level are important factors associated with perceived safety of alternative proteins, while age appears to play a more limited role.

Willingness to try followed a similar trend to safety perceptions: plant proteins were the most accepted (59.4%), followed by cultured meat (7.9%), while edible insects were least accepted (5.01%) (Figure 3). Motivations to try APs are illustrated in Figure 4. Health benefits were the primary driver for plant proteins, environmental sustainability for cultured meat, and novelty for edible insects. Regulatory reassurance and animal welfare also influenced acceptance, though to a lesser degree. These findings align with earlier research indicating that perceived personal and environmental benefits are central to AP adoption (Pakseresht et al., 2022).

Barriers to AP acceptance (Figure 5) revealed strong product-specific differences. Edible insects were overwhelmingly rejected as

‘off-putting’ (82.5%) and ‘unnecessary’ (39.2%), while cultured meat was described as ‘off-putting’ by 45% of participants. Concerns about taste and preference for traditional meats also featured prominently, echoing findings from Amoneit et al. (2025) and Wassmann et al. (2021) on the role of disgust and neophobia in limiting insect consumption. Even with incentives or assurances, more than half of participants indicated that nothing would convince them to try edible insects. When asked about specific formats, reluctance was strongest for whole insects (74.1%), whereas ground insects elicited slightly higher acceptance (21.9%), suggesting greater acceptance when visual cues were minimised.

Health benefits were the most cited motivator for trying APs, though many participants lacked sufficient information, particularly about the nutritional value of cultured meat and edible insects. Misconceptions were common: 39.2% believed insects were unnecessary, 19.2% thought they were unhealthy, and the same percentage deemed cultured meat unhealthy. These misun-

	Age			Gender		Education		BMI			Dietary Patterns		
	<25	25-44	>45	Male	Female	Secondary	Post secondary	<18.5	18.5–24.9	25–29.9	No specific diet	MD/ HPD	Vegetarian /Vegan
Do you think plant proteins are safe or unsafe?													
Very safe	39	102	99	83	158	9	229	12	92	122	167	15	18
Somewhat safe	19	74	71	47	114	9	154	5	55	97	137	6	1
Neither safe nor unsafe	9	15	20	15	29	5	39	1	13	29	39	1	1
Somewhat unsafe	2	7	6	7	8	0	15	1	4	9	11	2	0
Very unsafe	1	6	7	2	12	1	13	0	6	8	9	3	0
P - value (X2) < 0.05	0.136			0.401		0.016		0.655			0.396		
Do you think edible insects are safe or unsafe?													
Very safe	13	30	20	36	27	0	62	2	23	37	47	0	6
Somewhat safe	21	42	49	42	70	3	108	4	42	61	91	8	5
Neither safe nor unsafe	19	58	53	48	82	8	122	3	44	77	93	7	5
Somewhat unsafe	12	39	45	19	75	3	93	7	30	53	72	10	7
Very unsafe	6	35	35	10	66	9	66	3	31	38	60	2	2
P - value (X2) < 0.05	0.312			<0.001		<0.001		0.662			0.359		
Do you think lab-grown meat is safe or unsafe?													
Very safe	2	15	17	18	16	0	33	2	10	19	24	2	4
Somewhat safe	22	38	31	35	57	7	83	0	36	51	74	3	4
Neither safe nor unsafe	19	56	62	42	90	7	130	3	51	78	101	7	6
Somewhat unsafe	20	72	61	41	111	6	146	9	56	81	117	12	4
Very unsafe	8	23	31	16	46	4	58	5	17	36	47	3	2
P - value (X2) < 0.05	0.138			0.025		0.135		0.182			0.256		

Figure 2: Overview of the associations between demographic factors and safety perception of AP terms.

Table 3: Ordinal logistic regression analysis of perceived safety of APs.

Predictor	Edible insects		Lab-grown meat	
	OR (95% CI)	p-value	OR (95% CI)	p-value
<i>Age group (ref: >45 years)</i>				
16–25	2.17 (1.32–3.58)	0.002	1.43 (0.87–2.36)	0.156
26–44	1.16 (0.81–1.65)	0.419	1.10 (0.77–1.57)	0.602
<i>Education (ref: tertiary)</i>				
Secondary or lower	0.26 (0.12–0.56)	<0.001	0.93 (0.44–1.98)	0.849
Post-secondary	0.38 (0.25–0.59)	<0.001	0.54 (0.35–0.84)	0.006
<i>Gender (ref: male)</i>				
Female	0.38 (0.27–0.54)	<0.001	0.61 (0.43–0.87)	0.007

Model fit (edible insects): Wald $\chi^2 = 46.43$, $p < 0.001$ Proportional odds test: $\chi^2 (15) = 18.894$, $p = 0.219$
 Model fit (lab-grown meat): Wald $\chi^2 = 15.01$, $p = 0.002$ Proportional odds test: $\chi^2 (15) = 19.503$, $p = 0.192$

Reference categories: males, age >45 years, tertiary education.

understandings underscore the need for clearer public education, as insects, for example, are high in protein (Poortvliet et al., 2019).

Animal welfare was also a strong motivator for choosing cultured meat, aligning with research indicating that ethical concerns increas-

ingly influence consumer choices (Pakseresht et al., 2022). However, food neophobia and disgust remained major barriers, especially for edible insects. Similar findings were reported in a German study, which highlighted that reluctance toward unfamiliar foods strongly influences Ger-

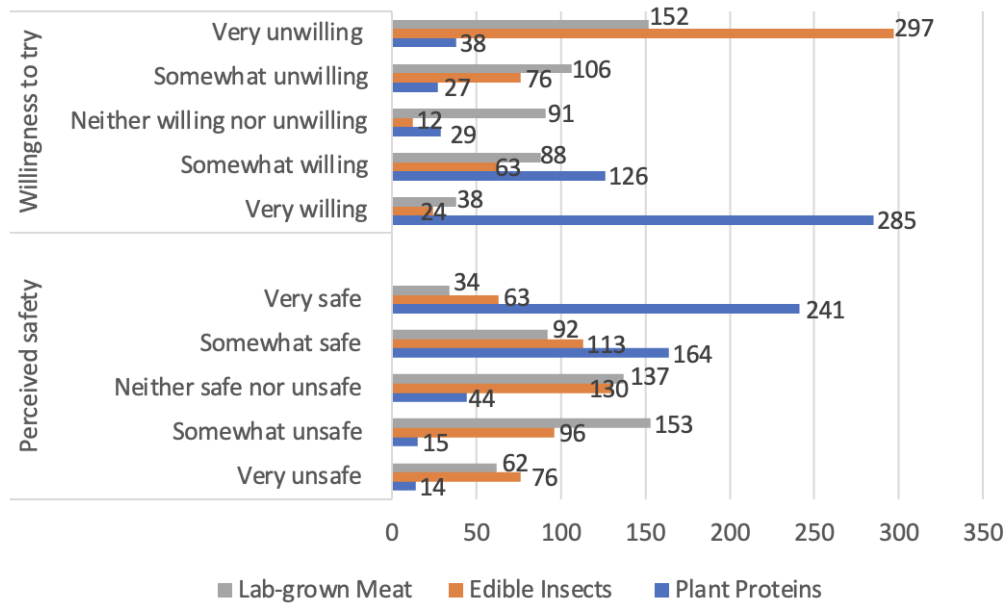


Figure 3: Consumer perceptions of safety and willingness to purchase alternative proteins.

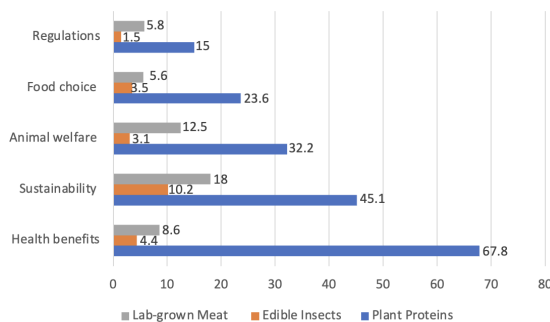


Figure 4: Motivators influencing consumers to try APs.

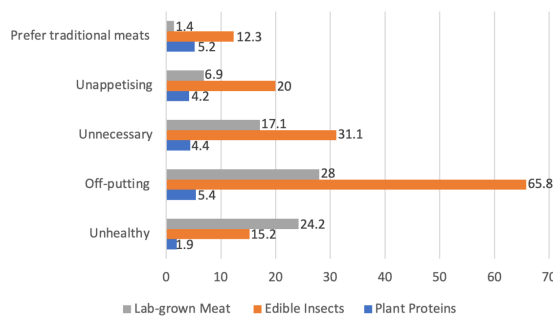


Figure 5: Main consumer barriers to trying APs.

man consumers' willingness to try insect-based products (Amonet et al., 2025). Consistent with findings by Wassmann et al. (2021), the most common reasons for rejection were disgust and anticipated unpleasant taste. Similarly in this study, 82.5% of participants found insects off-putting, with 45% reporting similar aversion toward cultured meat as previously shown from Figure 5. Over half said that nothing would convince them to try edible insects. Ground insect formats had slightly higher acceptance (11.3%) than whole insects (3%), suggesting that reducing visibility may help but won't eliminate aversion.

As per a recent study by Su et al. (2025), environmental concerns also influenced willingness. Nearly half indicated willingness to try plant-based proteins for sustainability reasons, and about a third felt the same about cultured meat. While insects and cultured meat are environmentally sustainable, scepticism remains, especially toward ultra-processed plant-based products. Despite being plant-based, items like pre-made patties may be seen as less sustainable due to additives, palm oil, and industrial processing (Davidou et al., 2020; Fardet & Rock, 2020). Messaging around sustainability should differen-

tiate between whole foods and processed alternatives.

Regulatory gaps also hinder the acceptance of AP. About 11% of participants expressed concern over the safety of insect regulation, and 28% over cultured meat. A lack of clear legal frameworks and safety evaluations increases consumer mistrust and impedes industry growth (Finke et al., 2015; Siddiqui et al., 2022). Improved transparency and clearer regulatory guidelines could build consumer confidence. Limited product availability also appears to influence consumer reluctance. Across Mediterranean markets, edible insects and cultured meat remain scarce or unavailable, restricting opportunities for consumers to gain familiarity or trust. Despite EU approval for certain insect species, commercial availability in the region is still limited. Greater product visibility in stores and restaurants could help normalise their presence and improve public acceptance, as demonstrated by Nguyen et al. (2022).

While research on the health effects of APs is ongoing, further investigation is necessary to offer substantial evidence to the public regarding the significant health benefits achievable through simple dietary changes. Future studies should encompass all five APs rather than the three selected for this study. Limiting the focus to three APs presented challenges in sourcing appropriate materials. Therefore, future research should aim for a broader examination of alternative proteins to provide comprehensive insights. Additionally, future researchers should consider conducting in-depth statistical analyses to further explore the reasons behind acceptance and willingness.

4 Conclusions

APs offer a promising solution to the sustainability challenges linked to traditional protein sources such as meat, fish, and dairy products. They target pressing global issues like climate change and offer new possibilities for food businesses to innovate and create new protein-based products that align with global market trends (Liu, 2018). Plant-based foods, cultured meat, and edible insects may in some cases offer nutritional advantages compared with traditional

animal-derived meats, while also presenting new culinary possibilities. This advancement supports a diverse market for alternative protein foods, attracting consumers interested in reducing animal product consumption for environmental sustainability.

Findings from this study provide valuable insights into consumer perceptions and dietary habits within the Mediterranean context. While respondents were generally aware of APs and their potential health and environmental benefits, uncertainty and misinformation continue to limit their integration into everyday diets. The multivariable analyses further indicated that demographic factors such as age, gender, and education level were associated with perceived safety of certain APs, suggesting that targeted communication strategies may be required for different population groups. Leveraging the factors that enhance consumer acceptance such as perceived health value, safety, and sustainability could help reform traditional eating patterns and support the transition toward more sustainable food systems across Mediterranean populations. Broader research on awareness and knowledge of AP, and willingness to adopt these foods should inform government and public health initiatives to promote consumer education and trust. As knowledge increases and sustainable food options become more accessible, acceptance of APs is expected to grow, contributing to a more resilient and innovative food systems.

This study provided a substantial dataset to explore consumer perceptions of alternative proteins (APs) within the Mediterranean context. Although the use of an online survey enabled efficient and wide-reaching data collection, the sample was not fully representative of the Maltese population, with a predominance of highly educated female respondents. This distribution likely reflects participation patterns commonly observed in voluntary online surveys and may limit the generalisability of the findings. Therefore, the results should be interpreted as indicative of attitudes among the surveyed respondents rather than fully representative of the broader population. Future research should aim for more diverse demographic representation and explore in greater depth the factors influencing AP acceptance and reluctance. Expanding the scope

to include additional categories of alternative proteins would also provide a more comprehensive understanding of consumer attitudes across Mediterranean populations. Limited participation from older adults and individuals with lower education levels reflects trends observed in previous studies, where these groups were found to be less receptive to dietary innovation (Hartmann & Siegrist, 2017). Future research should aim for more diverse demographic representation and employ more extensive statistical analyses to explore in greater depth the factors influencing AP acceptance and reluctance. Expanding the scope to include all major AP categories would also provide a more comprehensive understanding of consumer attitudes across Mediterranean populations.

Governments, policymakers, and health professionals have a pivotal role in advancing consumer acceptance of APs. Collaboration between nutrition experts, public health authorities, and policymakers can facilitate dietary transformation through education and accessibility. Policy measures that encourage gradual, achievable shifts toward a planetary health dietary pattern may include subsidies or incentives for AP producers, transparent labelling standards, and robust regulatory frameworks to build consumer confidence. Public education campaigns delivered through social media, schools, and community initiatives can help dispel misconceptions by highlighting the environmental and nutritional benefits of APs, while practical strategies such as supermarket recipe displays can demonstrate simple ways to incorporate plant-based meals into flexitarian diets.

Further research should also address allergenicity, labelling requirements, and product development to enhance the sensory and nutritional attributes of APs, particularly edible insects and cultured meat, and the improvement of taste, texture, and safety perceptions, will be essential to align product innovation with consumer expectations and to support long-term adoption. Ultimately, achieving a fundamental shift from 'farm to fork' is essential to cultivate a culture of healthy and sustainable eating within Mediterranean societies, one in which APs are integrated naturally into everyday diets.

References

- Amoneit, M., Gellrich, L., & Weckowska, D. M. (2025). Consumer acceptance of alternative proteins: Exploring determinants of the consumer willingness to buy in germany. *Foods*, 14(14). <https://doi.org/10.3390/foods14142427>
- Berry, E. M. (2019). Sustainable food systems and the mediterranean diet. *Nutrients*, 11(9). <https://doi.org/10.3390/nu11092229>
- Boaitey, A., Clark, B., & Tiwasing, P. (2025). Sustainability considerations and willingness to try alternative proteins: Evidence from the uk. *Cleaner and Responsible Consumption*, 17. <https://doi.org/10.1016/j.clrc.2025.100313>
- Capone, R., Fersino, V., Stamataki, E., Cerezo, M., Kessari, M., Dernini, S., & Bilali, H. E. (2021). Sustainability of food systems in the mediterranean region. *New Medit*, 20(3), 131–143. <https://doi.org/10.30682/nmsi21i>
- Castro, M., & Chambers, E. (2019). Willingness to eat an insect based product and impact on brand equity: A global perspective. *Journal of Sensory Studies*, 34(2). <https://doi.org/10.1111/joss.12486>
- Cordts, A., Nitzko, S., & Spiller, A. (2014). Consumer response to negative information on meat consumption in germany. *International Food and Agribusiness Management Review*, 17(Special Issue A). <https://doi.org/10.22004/ag.econ.164599>
- Cuschieri, S., & Libra, M. (2021). Adherence to the mediterranean diet in maltese adults. *International Journal of Environmental Research and Public Health*, 18(1), 1–10. <https://doi.org/10.3390/ijerph18010010>
- Damigou, E., Faka, A., Kouvari, M., Anastasiou, C., Kosti, R. I., Chalkias, C., & Panagiotakos, D. (2023). Adherence to a mediterranean type of diet in the world: A geographical analysis based on a systematic review of 57 studies with 1,125,560 participants. *International Journal of Food Sciences and Nu-*

- trition*, 74(8), 799–813. <https://doi.org/10.1080/09637486.2023.2262781>
- Davidou, S., Christodoulou, A., Fardet, A., & Frank, K. (2020). The holistico-reductionist siga classification according to the degree of food processing: An evaluation of ultra-processed foods in french supermarkets. *Food & Function*, 11(3), 2026–2039. <https://doi.org/10.1039/C9FO02271F>
- EIT Food. (2022). European institute of innovation & technology (eit) food trust tracker. <https://www.eitfood.eu/projects/consumerobservatory/trustracker>
- European Environment Agency. (2018). *Environmental indicator report 2018: In support to the monitoring of the 7th environment action programme* (tech. rep.). <https://www.eea.europa.eu/en/analysis/publications/environmental-indicator-report-2018>
- European Food Safety Authority. (2023). Novel food section. <https://www.efsa.europa.eu/en/topics/topic/novel-food>
- FAO, IFAD, UNICEF, WFP, & WHO. (2020, July). *The state of food security and nutrition in the world 2020* (tech. rep.). <https://doi.org/10.4060/ca9692en>
- Fardet, A., & Rock, E. (2020, August). Ultra-processed foods and food system sustainability: What are the links? <https://doi.org/10.3390/SU12156280>
- Finke, M. D., Rojo, S., Roos, N., van Huis, A., & Yen, A. L. (2015). The european food safety authority scientific opinion on a risk profile related to production and consumption of insects as food and feed. <https://doi.org/10.3920/JIFF2015.x006>
- Garcia, S. N., Osburn, B. I., & Jay-Russell, M. T. (2020, January). One health for food safety, food security, and sustainable food production. <https://doi.org/10.3389/fsufs.2020.00001>
- Hartmann, C., & Siegrist, M. (2017, March). Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. <https://doi.org/10.1016/j.tifs.2016.12.006>
- Hartmann, C., & Siegrist, M. (2018). Development and validation of the food disgust scale. *Food Quality and Preference*, 63, 38–50. <https://doi.org/10.1016/j.foodqual.2017.07.013>
- Jarchlo, A. I., & King, L. (2022, January). *Survey of consumer perceptions of alternative, or novel, sources of protein* (tech. rep.). <https://doi.org/10.46756/sci.fsa.ncn554>
- Joshi, V., & Kumar, S. (2015). Meat analogues: Plant based alternatives to meat products - a review. *International Journal of Food and Fermentation Technology*, 5(2), 107. <https://doi.org/10.5958/2277-9396.2016.00001.5>
- Kareem, A., Billy, N., & Chris, F. B. B. (2025). Consumer acceptance of alternative proteins: A re-review. <https://doi.org/10.1080/87559129.2024.2405051>
- Liu, W. (2018). Fact sheet: Alternative protein. <https://www.nottingham.ac.uk/biosciences/documents/business/food-innovation-centre/food-waste-alternative-protein-event-2018/fact-sheet-alternative-protein-dr-wentao-liu.pdf>
- Malila, Y., Owolabi, I. O., Chotanaphuti, T., Sakdibhornsup, N., Elliott, C. T., Visessanguan, W., Karoonuthaisiri, N., & Petchkongkaew, A. (2024, December). Current challenges of alternative proteins as future foods. <https://doi.org/10.1038/s41538-024-00291-w>
- Mina, G., Peira, G., & Bonadonna, A. (2023). The potential future of insects in the european food system: A systematic review based on the consumer point of view. *Foods*, 12(3). <https://doi.org/10.3390/foods12030646>
- National Statistics Office. (2023). Demography - population. <https://nso.gov.mt/demography-population/>
- Nguyen, J., Ferraro, C., Sands, S., & Luxton, S. (2022, September). Alternative protein consumption: A systematic review and future research directions. <https://doi.org/10.1111/ijcs.12797>
- Onwezen, M. C., Bouwman, E. P., Reinders, M. J., & Dagevos, H. (2021, April). A systematic review on consumer accep-

- tance of alternative proteins: Pulses, algae, insects, plant-based meat alternatives, and cultured meat. <https://doi.org/10.1016/j.appet.2020.105058>
- Pakseresht, A., Kaliji, S. A., & Canavari, M. (2022, March). Review of factors affecting consumer acceptance of cultured meat. <https://doi.org/10.1016/j.appet.2021.105829>
- Poortvliet, P. M., Pas, L. V. D., Mulder, B. C., & Fogliano, V. (2019). Healthy, but disgusting: An investigation into consumers' willingness to try insect meat. *Journal of Economic Entomology*, 112(3), 1005–1010. <https://doi.org/10.1093/jee/toz043>
- Siddiqui, S. A., Alvi, T., Sameen, A., Khan, S., Blinov, A. V., Nagdalian, A. A., Mehdizadeh, M., Adli, D. N., & Onwezen, M. (2022, November). Consumer acceptance of alternative proteins: A systematic review of current alternative protein sources and interventions adapted to increase their acceptability. <https://doi.org/10.3390/su142215370>
- Smetana, S., Mathys, A., Knoch, A., & Heinz, V. (2015). Meat alternatives: Life cycle assessment of most known meat substitutes. *International Journal of Life Cycle Assessment*, 20(9), 1254–1267. <https://doi.org/10.1007/s11367-015-0931-6>
- Stubelj, M., Glešič, E., Žvanut, B., & Širok, K. (2025). Factors influencing the acceptance of alternative protein sources. *Appetite*, 210. <https://doi.org/10.1016/j.appet.2025.107976>
- Su, W., Zhang, Y. Y., & Sheng, J. (2025). Consumers' willingness to pay for alternative protein food products: Taste preference, health, and environmental concerns. *Applied Economics*, 57(54), 9168–9184. <https://doi.org/10.1080/00036846.2024.2408035>
- Treki, Y. M., & Jones, P. (2021). Adherence to the mediterranean dietary pattern among university students. <https://doi.org/10.14614/MEDITERRDIET/8/21>
- Wassmann, B., Siegrist, M., & Hartmann, C. (2021). Correlates of the willingness to consume insects: A meta-analysis. *Journal of Insects as Food and Feed*, 7(5), 909–922. <https://doi.org/10.3920/JIFF2020.0130>