Socio-Demographic and Behavioural Determinants of Consumer Attitudes to Cell-Based Meat and Insect-Flour-Based Products: An Empirical Study of Italians' Propensity to Accept New Foods for Human Nutrition and Pet Food

Giacomo Degli Antoni and Marco Faillo

Abstract The chapter analyses the socio-demographic and behavioural factors affecting Italian consumer attitudes to cell-based meat and insect-flour-based products. We surveyed a representative sample of the Italian adult population and found that the vast majority of respondents were reluctant to consume cell-based meat and insect-based foods. Consumption intentions were more favourable to cell-based meat. In terms of health consequences, environmental benefits, effects on animal welfare and taste, respondents had more positive perceptions of cell-based meat than insect-based foods. Alignment with tradition was perceived to be higher for cell-based meat than for insect-based products. In general, our findings support existing evidence on the role of socio-demographic factors, such as age, gender, education and political attitude, as drivers of acceptance. We also provide new evidence that technological beliefs and trust in science positively affect consumption intentions for cell-based meat, but not for insect-based products. Finally, we provide new insights into the drivers of acceptance of such products for pet food.

Keywords Cell-based meat · Insect-based food · Novel foods · Consumer perception · Technological beliefs

G. Degli Antoni (✉)
University of Parma, Department of Law, Politics and International Studies, Department of Excellence 2023–2027 "Food for Future", Parma, Italy
e-mail: giacomo.degliantoni@unipr.it

M. Faillo
University of Trento, Department of Economics and Management, Trento, Italy
e-mail: marco.faillo@unitn.it

G. Formici et al. (eds.), *Cell-Based Meat in the European Union and Beyond*,
https://doi.org/10.1007/978-3-032-14624-3_12

1 Introduction

Novel foods like insect-based foods and cell-based meat are increasingly seen as promising solutions to major global issues related to traditional food production.[1] This is particularly relevant in a scenario in which increased demand for meat, due to population and economic growth, especially in lower middle-income countries,[2] exposes the global population to potential aggravation of food insecurity, greenhouse gas emissions, land and water usage, soil contamination, zoonotic diseases and animal welfare. However, the contribution of novel foods to the transition to more sustainable production also depends crucially on consumer willingness to try and include them in their diets.

The empirical literature on attitudes to cell-based meat and insect-based foods has increased significantly in the last few years.[3] We now have fairly solid evidence of the major factors affecting consumer acceptance of these two novel food categories, although it comes mostly from Western countries.[4] In terms of socio-demographic characteristics, for example, there is robust evidence of higher acceptance of novel foods in general, among younger educated urban consumers.[5] Males are generally more willing to try cell-based meat and insects.[6] Food habits and preferences, like high levels of meat consumption, are positively associated with willingness to try and consume cell-based meat.[7] Impulsive reactions play a central role as determinants of consumer acceptance of novel foods and can significantly affect food choice cost and benefit assessment.[8] Disgust, fear of contamination and apprehension are frequently mentioned in the literature as associated with rejection of cell-based meat and insect-based foods.[9] Consumers' attitudes are also strongly influenced by expected or actual product properties, like taste, texture, healthiness, price and nutritional content.[10] Familiarity, in terms of acquaintance or exposure, increases acceptance.[11] Other strongly supported determinants are

[1] Mazac et al. (2022).

[2] FAO (2003) and OECD-FAO (2024).

[3] Hanan et al. (2024), Monaco and Giraldi (2024) and Tsvakirai et al. (2024).

[4] Siddiqui et al. (2023) provide a comprehensive world-wide comparative analysis on the issue. See also *Navigating Consumer Acceptance of Cultured Meat: Insights from Social Science Research* by Lin-Hi and Brudorf in this volume.

[5] Siegrist and Hartmann (2020), Padhilla et al. (2021), Pakseresht et al. (2022), Jacobs et al. (2024), Muiruri and Rickertsen (2024) and Giacalone and Jaeger (2023).

[6] Bryant and Barnett (2018), Andrić et al. (2023) and Siddiqui et al. (2022).

[7] Onwezen et al. (2021).

[8] Monaco and Giraldi (2024).

[9] Verbeke et al. (2015), Lammers et al. (2019), Onwezen et al. (2021), Kröger et al. (2022) and Siddiqui et al. (2023).

[10] Verbeke et al. (2015), Pakseresht et al. (2022), Wilks and Phillips (2019) and Tsvakirai et al. (2024).

[11] Hartmann and Siegrist (2017), Bryant and Barnett (2018), Onwezen et al. (2021), Pakseresht et al. (2022) and Monaco and Giraldi (2024).

information, ethical attitudes of consumers and cultural/social influences.[12] In the case of information, its impact depends not only on its content but also on how it is framed. In the case of cell-based meat, for example, information seems to increase resistance when descriptions are perceived to be too technical,[13] while it has a positive effect when it is interpreted as simple and transparent with respect to the regulation and cost/benefits of the product.[14] Ethical motivations and concern for animal welfare[15] and environmental sustainability have positive impacts on acceptance.[16] Cultural drivers are also important and may include the definition of food, religious beliefs and habits related to food preparation and consumption, and attachment to local traditions.[17] Social norms influence acceptance of novel foods by providing information on beliefs of what is appropriate in one's reference groups and may prevent consumers from trying alternative sources of proteins.[18] A negative impact on acceptance is associated with personal attitudes like neophobia, perceived unnaturalness and technophobia or distrust in the application of new technologies to food production.[19] Finally, distrust in science, technology, institutions and producers, together with conspiratorial ideation can act as barriers to acceptance.[20] Interesting evidence has also been collected on consumer acceptance of novel foods to feed their pets. For example, in a recent study, Fantechi[21] found that food neophobia and attention to environmental sustainability affect Italian consumers' attitudes to pet food.[22]

This chapter presents the results of an empirical analysis based on a dataset collected by means of an original questionnaire administered to a sample of 2102 respondents, representative of the adult population of Italy in terms of age groups, gender and macro-geographical area of residence. We analysed the effect of socio-demographic and behavioural factors on consumer attitudes to cell-based meat and insect-flour-based products. The main novelty of our approach resided in four aspects. First, we explored consumer acceptance of cell-based meat and insect-flour-based foods (specifically cricket or locust flour) by investigating not only respondents' consumption intentions, but also their perceptions in terms of safety for health, environmental impact, impact on animal welfare, consistency with local

[12] See *Who Hates Cultured Meat? Examining Public Opposition to Cellular Agriculture* by Broad and Glenna in this volume.

[13] Siegrist et al. (2018).

[14] Verbeke et al. (2015) and Laestadius and Caldwell (2015).

[15] See *Animal Welfare as a Constitutional Value: The Debate in Comparative Law and the Emerging Role of Cultivated Meat* by Piciocchi in this volume.

[16] Pakseresht et al. (2022).

[17] Siddiqui et al. (2022) and Gómez-Luciano et al. (2019). See also *Food Justice in Religious Laws: Hypotheses on Cultivated Meat* by Anello in this volume.

[18] Higgs (2015) and Onwezen et al. (2021).

[19] Hartmann and Siegrist (2017), Bryant and Barnett (2018) and Siegrist and Hartmann (2020).

[20] Wilks and Phillips (2019).

[21] Fantechi et al. (2024).

[22] See also Higa et al. (2021).

traditions and disgust. Second, we made a direct comparison of respondents' statements/attitudes about cell-based meat and insect-flour-based foods. Third, we considered behavioural drivers, such as impatience and risk attitude, which are underexplored in the literature on the topic. Fourth, we sought evidence of the socio-demographic and behavioural determinants of readiness to use cell-based meat and products made from insect flour to feed pets.

We found that the majority of respondents were unlikely to consume cell-based meat (74.69%) or increase their consumption, if any, of insect-based products (81.83%). We provide further support for existing evidence of the role of socio-demographic factors. We also found that acceptance of insect-flour-based products was lower among females, parents and risk-averse individuals, but these factors did not significantly impact attitudes to cell-based meat. Interestingly, trust in science and technology positively influenced attitude to cell-based meat consumption, but not to insect-flour-based foods. In terms of health consequences, environmental benefits, effects on animal welfare, taste and consistency with local food traditions, respondents have a more positive perception of cell-based meat than of insect-flour-based foods. Regarding novel ingredients in pet food, females, older individuals and right-wing respondents showed lower acceptance.

The chapter is organized as follows: in Sect. 2 we briefly review some of the recent evidence on Italian consumer acceptance of novel foods, with a focus on insect-based foods and cell-based meat. In Sect. 3 we describe the sample and the structure of the questionnaire and some descriptive statistics. In Sect. 4 we present our results on consumption intentions for cell-based meat and food products made from insect flour, and in Sect. 5 those on perceptions of the two food types. In Sect. 6 we explore the determinants of propensity to accept pet food containing cell-based meat or insect-based ingredients. Section 7 concludes.

2 Italian Consumer Acceptance of Cell-Based Meat and Insect-Based Foods: Recent Evidence

In the European Union (EU), the authorization procedure for Novel Foods (including insects and cell-based meat) is entirely centralised and binding for all Member States.[23] Despite this, in Italy, discussion on the commercialization of Novel Foods, especially cell-based meat and insect-based foods, is often at the centre of political debate and attracts public and media attention. The most striking case is the ban

[23] See the current Regulation (EU) 2015/2283 of the European Parliament and of the Council of 25 November 2015 on novel foods, amending Regulation (EU) no 1169/2011 of the European Parliament and of the Council and repealing Regulation (EC) no 258/97 of the European Parliament and of the Council and Commission Regulation (EC) no 1852/2001, in *Cell-Based Meat in the European Union: A Regulatory Crossroads* by Corazza and Formici in this volume.

endorsed by the Italian Parliament,[24] restricting the production, sale and import of cultivated cell-based meat in Italy, opening questions about its compliance with EU law.[25] A significant proportion of Italian consumers still seem to consider meat a fundamental and irreplaceable part of their diet and food culture, resulting in constant high per-capita consumption.[26] In this hostile context, understanding Italian consumers' opinions and attitudes to the two novel foods becomes even more urgent and interesting. In the last few years, we have witnessed an increase in studies, involving Italian respondents, aimed at measuring their willingness to try and/or consume novel foods and at identifying the main drivers of acceptance.[27]

Regarding insect-based foods, Menozzi,[28] for example, surveyed university students and reported little willingness to try insect-based products, females and respondents from southern Italy being less willing than the rest of the sample. Anticipated positive impacts on the environment and health were found to be the two main drivers of positive attitudes. In another study involving university students and faculty members, Sogari[29] confirmed the higher propensity of males to try these products, reporting a negative impact of food neophobia and a positive impact of familiarity on willingness to eat insect-based foods. La Barbera[30] conducted a laboratory experiment involving Italian students, providing further evidence of the negative impact of neophobia on willingness to eat insect-based products, though the variable's explanatory power was lower than that of disgust. Similar results were found by Iannuzzi[31] using a convenience sample of Italian citizens recruited online. Palmieri[32] conducted a study with a larger sample (n = 456) of Italian citizens living in four central-southern regions of the country, finding that only 17% of respondents were inclined to try insect-based foods. They also found that willingness to eat insects was positively associated with familiarity, concerns for environmental and

[24] Law 1 December 2023, No. 172. *Disposizioni in materia di divieto di produzione e di immissione sul mercato di alimenti e mangimi costituiti, isolati o prodotti a partire da colture cellulari o di tessuti derivanti da animali vertebrati nonchè di divieto della denominazione di carne per prodotti trasformati contenenti proteine vegetali.* (23G00188) (Official Gazette General Series No. 281 of 1 December 2023), https://www.gazzettaufficiale.it/eli/id/2023/12/01/23G00188/sg. Accessed 31 March 2025.

[25] See on this topic *Cell-Based Meat in the European Union: A Regulatory Crossroads* by Corazza and Formici in this volume.

[26] Mancini and Antonioli (2020) and Aureli et al. (2023).

[27] See for example Mancini and Antonioli (2020) for a review of studies on Italian consumers' attitude toward alternatives to meat, covering years 2016–2020.

[28] Menozzi et al. (2017).

[29] Sogari et al. (2018).

[30] La Barbera et al. (2018).

[31] Iannuzzi et al. (2019).

[32] Palmieri et al. (2019).

public health, and negatively correlated with neophobia,[33] fear of negative health consequences, aversion to new food technology, female gender and age.[34]

Regarding cell-based meat, Mancini and Antonioli[35] conducted a survey involving 525 Italian consumers, recruited through an Italian consumer association and provided with information on the laboratory production process of cell-based meat and on its positive externalities. Interestingly, the authors also collected data on respondents' perceptions on cell-based meat's intrinsic attributes (safety, taste and nutritional properties in comparison with conventional meat) and on its extrinsic attributes (impact on animal welfare, food safety and environment). Respondents did not expect cell-based meat to be as tasty or more nutritious or safer than a conventional burger and were more convinced of its extrinsic attributes. About half the respondents (54%) stated that they were willing to try cell-based meat. Females, respondents with a low level of education, those unfamiliar with the concept of cell-based meat and respondents who did not consume meat were less willing to try cell meat than younger respondents, well-educated males, those familiar with the idea of cell-based meat, and meat eaters.[36] Willingness to buy and to pay were also measured: 44% of respondents were willing to buy cell-based meat and 23% would pay a premium over the price of conventional meat. Mancini and Antonioli[37] showed that providing information on positive externalities of cell-based meat to the same sample of participants had a positive impact on willingness to buy when the information concerned safety and nutritional features. Using an online survey (n = 490), Palmieri[38] found that 78% of respondents were willing to try cell-based meat, willingness increasing with concerns for the environment,[39] food safety, animal welfare and curiosity about new food, and decreasing with technophobia and age. Piochi et al.[40] conducted a survey experiment involving students and faculty staff (n = 717) in which they manipulated the information provided on the extrinsic attributes of cell-based meat. The negative impact of neophobia, female gender and age on willingness to try cultivated meat was confirmed. In line with the literature, they also found that willingness to try was generally higher than willingness to substitute conventional with cell-based meat. Willingness to substitute seemed to be positively influenced by information, irrespective of the attribute considered. In a more recent survey with a representative sample of the Italian adult population, Aureli[41] found low acceptance of both insect-based foods and cultivated meat as a substitute for

[33] See also Merlino et al. (2024).

[34] See also Palmieri et al. (2023).

[35] Mancini and Antonioli (2019).

[36] See also Roma et al. (2020).

[37] Mancini and Antonioli (2020).

[38] Palmieri et al. (2020).

[39] See also Castellani et al. (2025).

[40] Piochi et al. (2022).

[41] Aureli et al. (2023).

conventional meat. De Martini[42] investigated the relation between dietary styles (omnivores, vegetarians, vegans, flexitarians) and acceptance of different alternatives to meat, finding low willingness to try insect products and cell-based meat across dietary styles.

3 Sample, Descriptive Statistics and Method

3.1 Sample and Survey Structure

The empirical analysis was based on original data collected between October and November 2024 through online surveys taken by 2102 subjects.[43] The sample was representative of the adult Italian population in terms of age groups, gender and macro-geographical area of residence (north-west, north-east, centre and south).

The survey was organized in six sections. The first section collected socio-demographic data such as age, gender, place of birth and residence, education level and financial condition. The second section focused on attitudes and habits, asking about risk preferences, impatience, technological beliefs regarding the effect of science and technology on our lives, trust in science, scientific research and various institutions, political orientation, eating habits and level of concern about environmental issues, health and food safety, animal welfare, and rising prices for food and basic necessities. The third section provided definitions and information regarding the concept of novel foods as defined by the European Union, and explored participant perceptions of same, particularly cell-based meats and food products made from insect flour. The fourth section delved deeper into eating attitudes and perceptions toward cell-based meats and insect-flour-based foods, asking respondents about their consumption intentions with regard to these products. The fifth section examined participant opinions regarding the normative market-authorization process, with particular reference to the European level. The sixth section concluded with two questions on whether the information about novel foods was sufficiently clear, and about respondents' perceptions regarding any political bias of the questions included in the survey. Between Sects. 3 and 4, surveys completed by half the sample included detailed information on the marketing authorization process in the European Union. This additional information aimed to investigate the effect of the information on attitudes to eating novel foods. However, in this chapter we do not examine the effect of information. But rather focus mainly on the questions in the

[42] De Martini et al. (2023).

[43] The survey was part of the research activities carried out within the project funded by the European Union under the Next Generation EU initiative, National Recovery and Resilience Plan (NRRP)—Mission 4, Component 2, Investment 1.3—Ministerial Call No. 341 of 15 March 2022 issued by the Ministry of University and Research; Project Code PE00000003, Ministerial Decree No. 1550 of 11 October 2022 granting the funding, project title: "ON Foods – Research and innovation network on food and nutrition Sustainability, Safety and Security – Working ON Foods."

first three sections. Only two variables based on questions from the fourth section of the questionnaire were used in the empirical analysis. When considering these two variables (Sect. 4), we restricted our attention to the 1051 participants who did not receive the above information, so that responses could be compared. Note that this sub-sample was also recruited to be representative of the adult Italian population in terms of age, gender and macro-geographical area of residence.

3.2 Descriptive Statistics

Descriptive statistics of all variables used in empirical analysis of the whole and the sub-sample of subjects (the latter did not receive information about the EU marketing-authorization process) are summarized in Table 8 of the Appendix.

In this section we describe the questions used to create the independent variables considered in the analysis and comment on the respective descriptive statistics. Dependent variables and respective descriptive statistics are analysed in detail in later sections.

Focusing on the whole sample, we had 51.43% of female respondents.[44] Average age was 50.93 years (min. = 18, max = 94; Standard Deviation (SD) = 16.602); 63.27% of respondents had children; 97.95% were Italian; 27.12% lived in NW Italy, 19.98% in the NE, 20.03% in the centre and 32.87% in the South (islands included); 34.95% of subjects had a university degree or higher qualification (Master or Ph.D.). Information on financial conditions was collected asking participants how well they were doing financially: 8.61% of participants replied comfortably; 67.65% acceptably; 21.03% that they barely get by and 2.71% really badly.

With respect to attitudes and preferences, we considered risk attitude, impatience, technological beliefs, trust in science and research, level of concern about various issues and political orientation (distribution of replies in Fig. 1a–f).

To measure risk aversion, we considered a validated measure[45] based on the answers to the question: "Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please tick a box on the scale, where 1 means: 'unwilling to take risks' and 10: 'fully prepared to take risks'." The average score was 4.919 (SD = 2.411), 54.54% of respondents indicating a value below 6 (Fig. 1a).

To measure impatience/patience, we asked "How would you describe yourself: would you say that you are more impatient or patient? Please respond using the scale 0 (highly impatient) to 10 (very patient)." This question aimed to capture people's attitude to the future in terms of the discount rate applied to potential future benefits compared to present benefits. The average score was 6.658 (SD = 2.258), 29.32% of respondents indicating a value below 6 (Fig. 1b).

[44] Two respondents classified themselves as "other" in response to the question "Are you: male; female; other".

[45] Based on Dohmen et al. (2011).

Technological beliefs (Fig. 1c) and trust in science and research (Fig. 1d) were measured with two questions. The first, on technological beliefs, was taken from the World Values Survey (Wave 7), and asked respondents to score their agreement (1–10) with the following statement: "Science and technology are making our lives healthier, easier and more comfortable." The average score was 6.642 (SD = 1.992). The second question was more general: "How much do you trust science and research?" with scores ranging from 1—I do not trust at all—to 5—I completely trust. The average score was 3.886 (SD = 0.779).

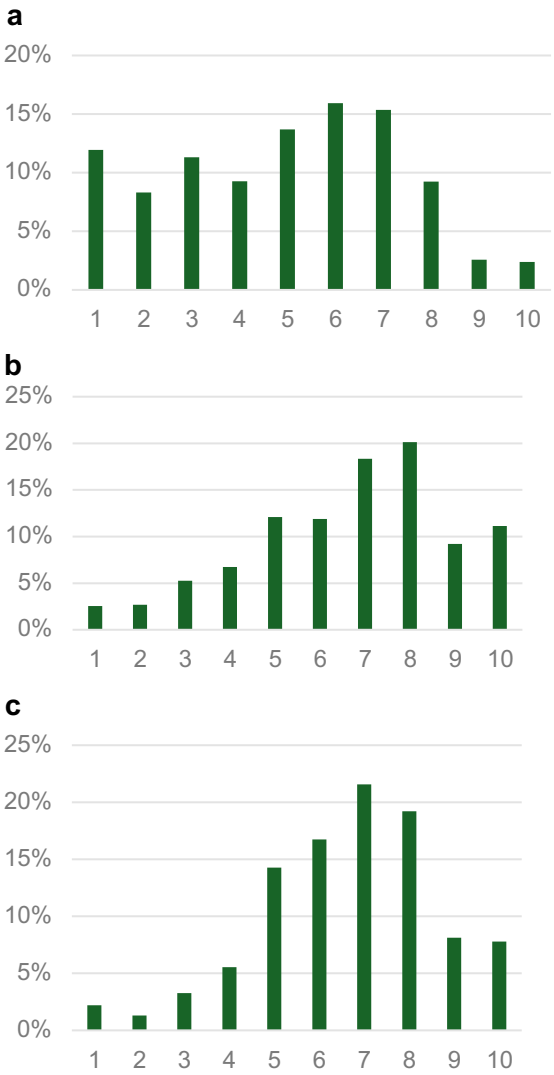

Fig. 1 (**a**) Risk propensity. (**b**) Patience. (**c**) Technological beliefs. (**d**) Trust in science and research. (**e**) Concerns. (**f**) Political orientation

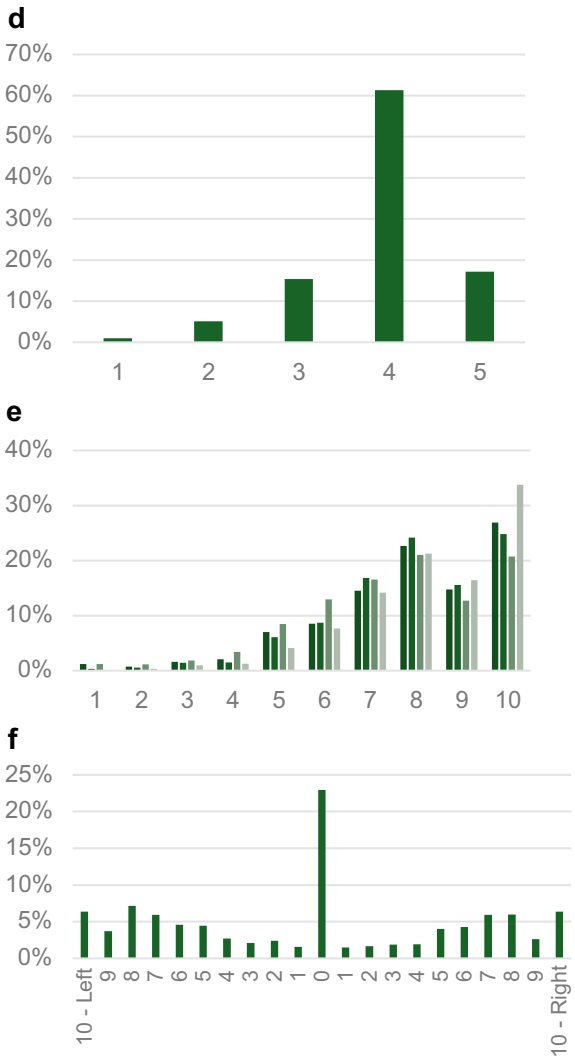

Fig. 1 (continued)

We also asked participants to score their concern about four issues on a scale from 1 (not worried at all) to 10 (completely worried): environmental issues—7.865 (SD = 1.980); health and food safety—7.939 (SD 1.781); animal welfare—7.484 (SD = 2.034); and rising prices of food and basic necessities—8.302 (SD = 1.680) (Fig. 1e, where the columns represent the same concerns, respectively, from left (dark grey) to right (light grey)).

Finally, to capture political orientation, we asked participants to mark their position on an integer scale (10—0—10), where 10 represented the two extremes of the political spectrum (Fig. 1f). We coded responses from 1 (10 on the right of the scale) to 21 (10 on the left of the scale). The average position was 10.715 (SD = 6.215).

3.3 Plan of Analysis

To investigate people's attitudes to novel foods, particularly cell-based meat and food products made from insect flour, we conducted a three-stage analysis. First, we examined subjects' propensity to consume cell-based meat if its commercialization is approved, and their willingness to increase consumption of insect-flour-based foods in the future, along with the determinants of these behaviours (Sect. 4). Second, we analysed people's level of agreement with five statements concerning cell-based meat and foods made from insect flour: "safety/health," "consistency with traditions," "environmental benefits," "animal welfare," and "disgust." We also investigated the factors influencing the answers to these questions, comparing attitudes to cell-based meat and insect food products and analysing the determinants of these differences (Sect. 5). Finally, we studied subjects' propensity to buy cell-based meat (if available) and insect-flour-based products for pet food (Sect. 6).

4 Consumption Intentions Regarding Cell-Based Meat and Food Products Made from Insect Flour

Two questions were specifically aimed at investigating future consumption intentions for cell-based meat and food made from insect flour, with specific reference to cricket or locust flour.[46]

Since cell-based meat is not yet available on the market in the EU, to study consumers' intentions regarding this product, we asked: "How likely are you to consume cell-based meat in future if it becomes commercially available?" Conversely, since food made from insect flour obtained from certain authorized species is already available on the market, we could not exclude the possibility that some respondents were already consuming it. We therefore also asked: "How likely are you to increase your consumption of products made from cricket or locust flour in the future?". The answer options were the same in both cases: 1 "completely unlikely"; 2 "very unlikely"; 3 "quite unlikely"; 4 "quite likely"; 5 "very likely"; 6 "completely likely".

Figure 2 shows clearly that the vast majority of participants considered unlikely an increase in their future consumption of cell-based meat (74.69% of respondents) or products made from cricket or locust flour (81.83%). In general, the distribution of responses revealed greater willingness to consume cell-based meat than to increase consumption of products made from insect flour: 4% of respondents stated that they were completely likely to consume cell-based meat in the future if it

[46] The independent variables used to study consumption intentions concerning products made from insect flour were based on questions specifically referring to cricket or locust flour. Conversely, when referring to perceptions, we opted for a broader definition of foods, asking about "insect-flour-based products" in general.

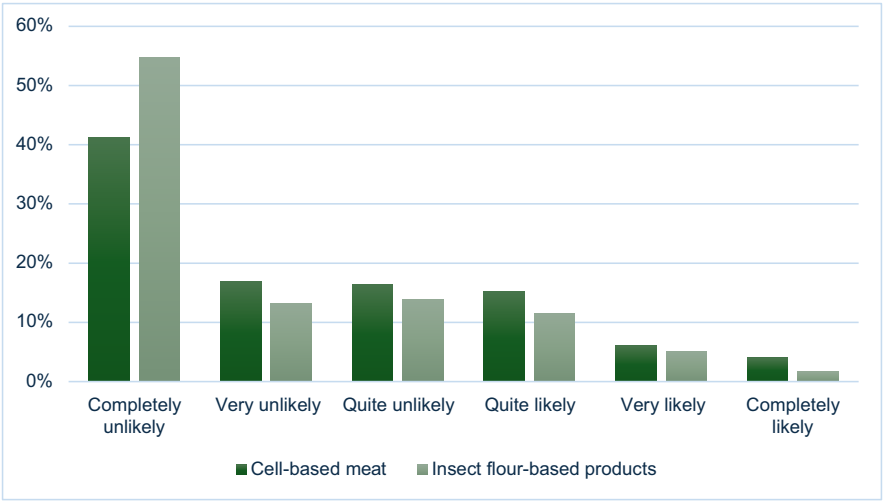

Fig. 2 Willingness to consume cell-based meat and to increase consumption of foods made from insect flour

became available, 6.09% that they were very likely to do so, and 15.22% that they were quite likely. The corresponding percentages related to the probability of increasing consumption of insect-based products were 1.71%, 5.04% and 11.42% (Fig. 2).

In the next section, we see that the gap in consumption intentions between the two novel foods appears to be linked to lower levels of liking and trust towards insect-based products than cell-based meat.

In line with the literature (Sect. 1) we assessed the effect of socio-demographic factors on consumption decisions regarding the two novel foods; we also added a set of measures of behavioural attitudes and technological beliefs, hitherto less investigated. We estimated the following equations using standard Ordinary Least Squares (OLS):

$$a_{i=}\alpha + x_i\beta + z_i\gamma + \varepsilon_i \tag{1}$$

$$b_{i=}\alpha + x_i\beta + z_i\gamma + \varepsilon_i \tag{2}$$

where a_i and b_i are the consumption intentions of individual i for cell-based meat and products made from cricket or locust flour, respectively, as captured by the above questions; x_i is a vector of socio-demographic controls and z_i is a vector of behavioural variables; ε_i is the independently distributed random term.

The socio-demographic variables included in vector x_i were: gender; age; having children; education level captured by a dummy equal to 1 if the respondents had a university degree or higher qualification; financial conditions; dummies related to the macro-region of residence[47] (see Sect. 2 and Table 8 of Appendix). Behavioural determinants and attitudes included in z_i were: risk preferences; impatience; technological beliefs and trust in science and research; level of concern about environmental issues, food safety/health; animal welfare; rising prices of food and basic necessities; political orientation.

Table 1 shows the results estimated by Eqs. (1) and (2). Interesting similarities and differences emerged between the determinants of future consumption intentions for the two novel foods.

Regarding similarities, we observed that persons less likely to consume cell-based meat or to increase their future consumption of products made from insect flour were older, less educated, more concerned about the rising price of food and basic necessities, and had a more right-wing political orientation. Impatient character and concern for animal welfare were not found to affect consumption intentions of either novel food.

Table 1 Determinants of consumption intentions regarding cell-based meat and foods made from insect flour

	(1)	(2)
	Consumption intentions: cell-based meat	Consumption intentions: insect-flour-based products
Method	OLS	OLS
Female	−0.154 (0.094)	−0.184* (0.088)
Age	−0.023** (0.003)	−0.017** (0.003)
Parents	−0.186 (0.109)	−0.259* (0.102)
Graduate	0.215* (0.099)	0.184* (0.093)
Financial condition	0.054 (0.080)	0.103 (0.075)
North-West	0.285* (0.119)	0.152 (0.111)
North-East	0.096 (0.129)	0.119 (0.121)

(continued)

[47] The empirical literature on acceptance of novel foods (Sect. 1) reveals a difference between urban and non-urban consumers. We did not explicitly seek this information in our questionnaire but verified the effect on our dependent variables of a dummy which takes the value of 1 for respondents living in towns with population < 10,000. This variable was not statistically significant [pr. = 0.502 and pr. = 0.759 in Eqs. (1) and (2) of Table 1, respectively]. Since being urban or non-urban consumers may be disconnected from the size of the town of residence, we opted for including only a control related to the macro-area of residence.

Table 1 (continued)

	(1)	(2)
Centre	0.144 (0.126)	0.046 (0.118)
Risk attitude	0.032 (0.021)	0.054** (0.019)
Patience	−0.006 (0.021)	−0.006 (0.020)
Technological beliefs	0.061* (0.026)	0.017 (0.025)
Trust in science	0.158* (0.071)	0.103 (0.066)
Political orientation	−0.043** (0.007)	−0.040** (0.007)
Concern_environment	0.071* (0.035)	0.080 (0.033)
Concern_health	−0.077* (0.035)	−0.052 (0.033)
Concern_animal welfare	0.054 (0.031)	0.003 (0.029)
Concern_prices	−0.129** (0.034)	−0.135** (0.032)
Constant	3.468** (0.480)	3.335** (0.448)
Observations	882	882
Adj R-squared	0.2365	0.1995
β(North-West) = β(North-East)	0.190 (0.136)	0.033 (0.127)
β(North-West) = β(Centre)	0.142 (0.134)	0.106 (0.125)
β(North-East) = β(Centre)	−0.048 (0.144)	0.073 (0.135)

Last rows show *lincom* (linear combinations of parameters) test of equality of coefficients
**p < 0.01; *p < 0.05; *p < 0.1

Regarding differences in terms of socio-demographic factors, females and persons with children were less likely to increase their consumption of insect-flour-based products. The two variables had no effect on cell-based meat consumption intentions. Respondents living in NW Italy showed higher intentions of consuming cell-based meat than those living in the South. No other regional differences emerged.

With regard to behavioural determinants and attitudes, we found that trust in science and research and positive technological beliefs had a positive impact on cell-based meat consumption intentions, but did not affect intention to increase consumption of insect-based products.

People more concerned about health problems related to food and less concerned about environmental issues were less likely to start consuming cell-based meat, were it available.

Finally, respondents who were more risk-averse tended to declare a lower probability of increasing their consumption of insect-based products, whereas no effect of risk aversion was observed for cell-based meat-consumption intentions.

5 Perceptions of Cell-Based Meat and Food Products Made from Insect Flour

In this section, we analyse the responses to five questions aimed at eliciting respondents' perceptions of cell-based meat and food made from insect flour. We asked participants to rate their level of agreement—from 0 (completely disagree) to 10 (completely agree)—with the following statements about the two products: "safe for health", "beneficial for the environment", "detrimental to animal welfare", "consistent with our traditions" and "disgusting".

5.1 Descriptive Statistics

Table 2 and Fig. 3 report the mean (and SD) and the distribution of responses to the ten questions, respectively. Two main pieces of evidence emerged from analysis of the responses.

First, apart from animal welfare which was of no concern for the vast majority of respondents, participants generally expressed concern about safety for health and environmental effects of both novel foods and perceived them as contrary to tradition and disgusting. The average responses regarding health/safety perceptions and environmental benefits were both below 6 for the two products. Regarding the distribution of responses (scored 0–10), a high percentage of respondents disagreed (scores <6) with the statement that cell-based meat and insect-flour-based products are safe for health (70.41% and 71.50%, respectively) and with the statement that they are beneficial for the environment (53.38% and 62.18%). Consistency with tradition was rated significantly low for both products (mean 1.980 for insect-based foods and 2.999 for cell-based meat), 76.93% and 85.82% of respondents, respectively, expressing agreement scores below 6. Respondents who declared that cell-based meat and insect-flour-based foods disgusted them represented the 52.90% and the 78.70% of the sample, respectively; their mean agreement scores were 5.939 and 7.044, respectively.

Table 2 Average responses concerning beliefs about cell-based meat and insect-flour-based products

	Safe for health	Beneficial for environment	Detrimental to animal welfare	Consistent with tradition	Disgusting
Cell-based meat	4.173 (2.865)	5.063 (2.988)	4.376 (3.076)	2.998 (3.083)	5.939 (3.362)
Insect-based foods	3.833 (3.004)	4.378 (3.088)	4.627 (3.192)	1.980 (2.771)	7.044 (3.396)
Paired t-tests for the null hypothesis that average responses regarding perception of the two novel foods is the same	t = 6.380 Pr (T < t) = 1.0000	t = −3.596 Pr(T < t) = 1.0000	t = 11.608 Pr(T < t) = 1.0000	t = 17.066 Pr(T < t) = 1.0000	t = −14.452 Pr(T < t) = 1.0000

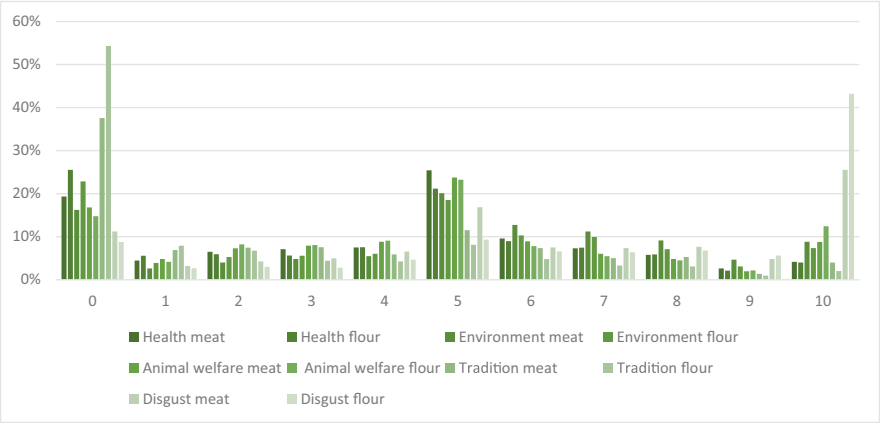

Fig. 3 Distribution of responses concerning perception of cell-based meat and insect-based products

Second, on average, perceptions were significantly more favorable to cell-based meat in terms of health/safety, environmental benefits, animal welfare and taste. Alignment with local tradition was perceived as higher for cell-based meat than for insect-based products. The paired t-tests in the last row of Table 2 reveal statistically significant differences in average responses for the two novel foods.

5.2 Determinants of Perception of Cell-Based Meat and Insect-Based Products

To investigate the determinants of people's perception of cell-based meat and foods made from insect flour, we performed multivariate analysis on the responses to each of the above *perception* questions using OLS according to the following equation:

$$c_{i=}\alpha + x_i\beta + z_i\gamma + \varepsilon_i \tag{3}$$

where c_i is individual i's level of agreement with the different statements about the two products; x_i is a vector of socio-demographic controls and z_i is a vector of behavioral variables as for Eqs. (1) and (2); ε_i is the independently distributed random term. The results are shown in Tables 3 and 4.

Analysis of the determinants of respondents' perceptions had two main goals. On the one hand, it aimed to explore similarities and differences across the various dimensions of perception (i.e. health/safety, environment, animal welfare, alignment with tradition and taste) of a given product category (cell-based meat or

Table 3 The determinants of perceptions about cell-based meat

	(1)	(2)	(3)	(4)	(5)
	Safe for health	Beneficial for the environment	Detrimental to animal welfare	Consistent with tradition	Disgusting
Method	OLS	OLS	OLS	OLS	OLS
Female	−0.341** (0.126)	−0.257 (0.134)	0.290* (0.142)	−0.160 (0.138)	0.389* (0.159)
Age	−0.024** (0.004)	−0.034** (0.005)	−0.003 (0.005)	−0.043** (0.005)	0.023** (0.005)
Parents	−0.334* (0.146)	−0.134 (0.156)	0.190 (0.166)	−0.161 (0.161)	0.208 (0.185)
Graduate	0.362** (0.132)	0.250 (0.141)	−0.098 (0.150)	0.330* (0.146)	−0.333* (0.167)
Financial condition	0.061 (0.110)	0.002 (0.118)	0.021 (0.125)	−0.010 (0.121)	−0.049 (0.139)
North-West	0.421** (0.159)	0.458** (0.169)	−0.260* (0.180)	0.434* (0.175)	−0.292 (0.200)
North-East	0.209 (0.173)	0.220 (0.184)	−0.485 (0.196)	0.019 (0.190)	−0.410 (0.218)
Centre	0.342* (0.170)	0.283 (0.182)	−0.089 (0.193)	0.388* (0.188)	−0.102 (0.215)
Risk attitude	0.136** (0.027)	0.110** (0.029)	0.058 (0.031)	0.106** (0.030)	−0.039 (0.035)
Patience	−0.011 (0.028)	−0.112** (0.030)	0.104** (0.032)	−0.005 (0.031)	0.057 (0.036)
Technological beliefs	0.136** (0.036)	0.165** (0.039)	0.012 (0.041)	0.153** (0.040)	0.011** (0.046)
Trust in science	0.535** (0.094)	0.686** (0.100)	−0.643** (0.106)	0.126 (0.103)	−0.586 (0.118)
Political orientation	−0.075** (0.010)	−0.073** (0.011)	0.067** (0.011)	−0.085** (0.011)	0.079** (0.013)
Concern_environment	0.137** (0.044)	0.239** (0.047)	−0.109* (0.050)	0.063 (0.048)	−0.116* (0.056)
Concern_health	−0.090* (0.046)	−0.034 (0.049)	−0.038 (0.052)	−0.076 (0.051)	0.118* (0.058)
Concern_animal welfare	0.074 (0.041)	0.106* (0.044)	0.143** (0.046)	0.133** (0.045)	0.005 (0.052)
Concern_prices	−0.258** (0.045)	−0.201** (0.048)	0.037 (0.051)	−0.286** (0.050)	0.182** (0.057)
Constant	3.641** (0.630)	3.129** (0.671)	4.914** (0.713)	5.417** (0.693)	4.478** (0.795)
No. observations	1767	1767	1767	1767	1767
Adj R-squared	0.2131	0.2281	0.0689	0.1809	0.0943
β(North-West) = β(North-East)	0.218 (0.180)	0.238 (0.192)	0.225 (0.204)	0.415* (0.198)	0.118 (0.228)
β(North-West) = β(Centre)	0.793 (0.180)	0.175 (0.192)	−0.171 (0.204)	0.046 (0.198)	−0.189 (0.227)
β(North-East) = β(Centre)	−0.133 (0.193)	−0.063 (0.205)	−0.396 (0.219)	−0.369 (0.212)	−0.308 (0.244)

Last rows show *lincom* (linear combinations of parameters) test of equality of coefficients
**p < 0.01; *p < 0.05; *p < 0.1

Table 4 The determinants of perceptions about foods made from insect flour

	(1)	(2)	(3)	(4)	(5)
	Safe for health	Beneficial for the environment	Detrimental to animal welfare	Consistent with tradition	Disgusting
Method	OLS	OLS	OLS	OLS	OLS
Female	−0.268* (0.134)	−0.378** (0.142)	0.285 (0.149)	−0.207 (0.127)	0.683** (0.161)
Age	−0.023** (0.005)	−0.030** (0.005)	0.003 (0.005)	−0.031** (0.004)	0.006 (0.006)
Parents	−0.449** (0.156)	−0.237 (0.166)	−0.054 (0.173)	−0.059 (0.148)	−0.057 (0.188)
Graduate	0.391** (0.141)	0.164 (0.150)	−0.206 (0.157)	0.263* (0.134)	−0.295 (0.170)
Financial condition	0.041 (0.118)	0.178 (0.125)	−0.101 (0.130)	−0.039 (0.111)	−0.035 (0.141)
North-West	0.518** (0.169)	0.463* (0.179)	−0.353 (0.188)	0.097 (0.160)	−0.918** (0.203)
North-East	0.607** (0.185)	0.532** (0.196)	−0.352 (0.204)	0.171 (0.175)	−0.601 (0.222)
Centre	0.268 (0.182)	0.258 (0.193)	0.133 (0.201)	0.184 (0.172)	−0.267 (0.218)
Risk attitude	0.133** (0.029)	0.123** (0.031)	0.022 (0.032)	0.190** (0.028)	−0.124** (0.035)
Patience	−0.005 (0.030)	−0.017 (0.032)	0.097** (0.033)	0.042 (0.028)	0.081* (0.036)
Technological beliefs	0.126** (0.039)	0.135** (0.041)	−0.033 (0.043)	0.045 (0.036)	−0.002 (0.046)
Trust in science	0.392** (0.100)	0.404** (0.106)	−0.492** (0.111)	0.108 (0.094)	−0.219 (0.120)
Political orientation	−0.084** (0.011)	−0.083** (0.011)	0.038** (0.012)	−0.052** (0.010)	0.065** (0.013)
Concern_environment	0.190** (0.047)	0.279** (0.050)	−0.217** (0.052)	0.056 (0.044)	−0.074 (0.056)
Concern_health	−0.120* (0.049)	0.016 (0.052)	0.027 (0.054)	−0.075 (0.047)	0.079 (0.059)
Concern_animal welfare	0.015 (0.044)	−0.003 (0.046)	0.140** (0.048)	0.062 (0.041)	−0.005 (0.052)
Concern_prices	−0.240** (0.048)	−0.334** (0.051)	0.044 (0.053)	−0.331** (0.046)	0.270** (0.058)
Constant	4.058** (0.673)	3.782** (0.713)	5.934** (0.745)	4.624** (0.635)	5.107** (0.807)
No. observations	1767	1767	1767	1767	1767
Adj R-squared	0.1866	0.1939	0.0521	0.1594	0.0760
β(North-West) = β(North-East)	−0.089 (0.193)	−0.069 (0.204)	−0.001 (0.213)	−0.075 (0.181)	−0.316 (0.231)
β(North-West) = β(Center)	0.250 (0.192)	0.205 (0.204)	−0.486* (0.213)	−0.088 (0.182)	−0.651** (0.231)
β(North-East) = β(Centre)	0.339 (0.206)	0.274 (0.218)	−0.485* (0.228)	−0.013 (0.195)	−0.335 (0.247)

Last rows show *lincom* (linear combinations of parameters) test of equality of coefficients
**p < 0.01; *p < 0.05; *p < 0.1

insect-based products). On the other hand, it aimed to highlight similarities and differences in determinants of like perceptions of the two novel foods.

We first examine the determinants of perceptions of cell-based meat.

5.2.1 Cell-Based Meat

Safety for Human Health

We found that females, older individuals, those with children and without a university degree believed that cell-based meat is less safe for human health. Risk propensity, positive technological beliefs and trust in science and research increased perceptions that cell-based meat is safe; likewise for leftist political orientation. Regarding the effects of macro-area of residence, we found that people living in southern Italy perceived cell-based meat as less safe for health than those living in NW or central Italy. Finally, concerns about environmental issues positively affected perceptions on the health/safety of cell-based meat, while concerns about health effects and rising prices of food and basic necessities had a negative impact.

Environmental Effects

With respect to socio-demographic factors, we found that only age and area of residence affected the perception of beneficial environmental effects of cell-based meat, older people and those living in southern Italy believing it to be less beneficial for the environment than did younger people and those living in NW Italy. Like for perceptions about health/safety, we found that less risk-averse and left-leaning individuals, those with more positive technological beliefs and a higher level of trust in science and research were more likely to perceive cell-based meat as beneficial in terms of environmental effects. Concerns about environmental issues and animal welfare positively affected perceptions about the environmental benefits of cell-based meat, while concerns about rising prices had a negative effect.

Animal Welfare

Regarding the impacts of cell-based meat on animal welfare, we found that females, right-wing politically oriented individuals and those living in southern Italy were more likely than those living in the NW to consider them detrimental. Neither risk attitude nor technological belief in the positive effects of science and technology on people's lives affected perceptions about the effect of cell-based meat on animal welfare, whereas respondents having a higher level of trust in science and research believed the effects of cell-based meat on animal welfare to be less detrimental than those with a lower level of trust. Respondents who were less (more) concerned about environmental issues and animal welfare believed cell-based meat to be more (less) detrimental for animal welfare.

Tradition

Younger and more educated respondents tended to believe cell-based meat to be more aligned with tradition, as did left-leaning individuals, risk lovers and people with more positive technological beliefs. On the other hand, individuals living in southern Italy tended to believe it to be less aligned with tradition than those living in other regions of Italy. Concerns about animal welfare and rising prices of food

and basic necessities increased and decreased, respectively, perceptions that cell-based meat is in line with tradition.

Disgust
We found that females and older, right-leaning and less educated individuals were more likely to feel disgusted by cell-based meat. Trust in science and research and concerns about environmental issues tended to reduce feelings of disgust, while positive technological beliefs, concern about effects of diet and rising prices of food and basic necessities tended to increase them.

5.2.2 Insect-Flour-Based Foods

The determinants of perceptions about insect-based foods were analysed by highlighting the differences with respect to the determinants of perceptions about cell-based meat.

Regarding perceptions about health/safety and animal welfare, we found essentially the same determinants as for cell-based meat, except for a lack of significance of animal welfare concerns, a lack of gender effect and more negative perceptions of those living in central than NW Italy in relation to the detrimental effects on animal welfare.

With respect to perceptions on the environmental effects of insect-based products, we noted three differences: (1) the emergence of a gender effect, non-females believing more than females that these products harm animal welfare; (2) a lack of significance of impatience, that showed a negative correlation with perceptions of the environmental benefits of cell-based meat; and (3) a lack of significance of animal welfare concerns.

Perceptions of the compatibility of these products with traditions were not affected by geographical area of residence, technological beliefs or animal welfare concerns, all of which proved to have a positive correlation with perceptions about cell-based meat's compatibility with tradition.

Finally, many differences characterized the determinants of taste perception of insect-based products compared to those of cell-based meat. Significant factors were the female dummy variable (positive effect); geographical area of residence, respondents living in southern and central Italy more often declaring disgust than those in the NW; the level of risk aversion and impatience, less (more) risk averse (patient) respondents feeling more disgust; concern about rising prices was correlated with a higher perception of disgust; political orientation with right-leaning persons finding insect-based foods more disgusting than left-leaning respondents.

5.3 Determinants of Differences in Perception of Cell-Based Meat and Insect-Flour-Based Products

To analyse the determinants of differences in perceptions of the two types of product, we created a categorical variable ranging from −1 to 1 associated with different levels of agreement with the five statements, as they pertained to cell-based meat and insect-based products: "safe for health", "beneficial for the environment",

Table 5 Perceptions about cell-based meat (P_m) and foods made from insect flour (P_f)

	Safe for health (%)	Beneficial for the environment (%)	Detrimental to animal welfare (%)	Consistent with tradition (%)	Disgusting (%)
$P_m = P_f$	41.67	39.01	35.78	49.62	39.53
$P_m < P_f$	23.93	21.03	33.97	10.75	44.20
$P_m > P_f$	34.40	39.96	30.26	39.63	16.27

"detrimental to animal welfare", "consistent with traditions" and "disgusting". The variable was: equal to 1 for respondents who were more in agreement with a statement when it pertained to cell-based meat than insect-flour-based products; equal to 0 when agreement with a statement was exactly the same for the two products; equal to −1 for respondents who were less in agreement with a statement when it pertained to cell-based meat than insect-based products. Therefore, the variable took the value of 1 (or 0 or −1) for respondents who believed that cell-based meat was: (a) safer (equally safe; less safe) for health; (b) more (equally; less) beneficial for the environment; (c) less (equally; more) detrimental to animal welfare; (d) more (equally; less) aligned with tradition; (e) more (equally; less) disgusting than the insect product. Table 5 shows the percentage of 1, 0 and −1 values for each statement. The percentage of respondents providing the same replies (variable = 0) for the two products ranged from 35.78% for animal welfare to 49.62% for compatibility with tradition. In the case of respondents providing different replies, we found that perceptions regarding health/safety, beneficial environmental effects, detrimental effects on animal welfare and disgust were more favorable for cell-based meat than for insect-flour-based products. Cell-based meat was perceived as more consistent with tradition than insect-flour-based foods by 39.63% of respondents, while the opposite was true for 10.75% of respondents.

Table 6 presents ordered logit estimates investigating factors that increased the probability of replying to the five questions with a higher level of agreement for cell-based meat than for insect-flour-based foods. The dependent variables in the analysis were the five categorical variables described above.[48]

Only a few variables had a significant effect in explaining differences in respondents' perceptions of the two novel foods, and only two variables seemed to reveal effects that characterize multiple dimensions captured by our perception questions. The first was the level of trust in science and research which increased the probability of having a more favorable perception of cell-based meat in terms of environmental effects and also the probability that respondents, ceteris paribus, considered cell-based meat relatively more compatible with tradition and less disgusting than insect-flour-based products. The second variable was age, older individuals being more likely to perceive cell-based meat as less consonant with tradition, more disgusting and less detrimental for animal welfare than insect-flour-based products. Finally, respondents living in southern Italy were more likely than those living in

[48] Note that since our dependent variable takes three values (1; 0; −1), the comparison between P_m and P_f regards three alternatives: (a) $P_m = P_f$ vs $P_m < P_f$; (b) $P_m > P_f$ vs $P_m = P_f$; (c) $P_m > P_f$ vs $P_m < P_f$.

Table 6 The determinants of differences in perceptions of cell-based meat and foods made from insect flour

	(1)	(2)	(3)	(4)	(5)
	Differences in perceptions				
	Safe for health	Beneficial for the environment	Detrimental to animal welfare	Consistent with tradition	Disgusting
Method	Ologit	Ologit	Ologit	Ologit	Ologit
Female	−0.050 (0.093)	0.134 (0.093)	−0.027 (0.091)	0.017 (0.096)	−0.159 (0.094)
Age	−0.002 (0.003)	−0.003 (0.003)	−0.008* (0.003)	−0.008* (0.003)	0.011** (0.003)
Parent	0.139 (0.107)	0.132 (0.107)	0.165 (0.106)	−0.057 (0.111)	0.065 (0.110)
Graduate	−0.098 (0.098)	0.015 (0.098)	0.052 (0.097)	−0.015 (0.102)	0.047 (0.099)
Financial condition	0.000 (0.080)	−0.048 (0.081)	−0.019 (0.080)	0.002 (0.084)	0.004 (0.082)
North-West	−0.109 (0.117)	−0.083 (0.117)	0.058 (0.115)	0.227 (0.121)	0.165 (0.118)
North-East	−0.350** (0.127)	−0.322* (0.127)	−0.048 (0.126)	−0.298* (0.131)	0.051 (0.130)
Centre	−0.097 (0.125)	−0.052 (0.125)	−0.174 (0.125)	−0.010 (0.131)	0.024 (0.129)
Risk attitude	0.004 (0.020)	−0.021 (0.020)	−0.001 (0.020)	−0.032 (0.021)	0.029 (0.020)
Patience	−0.011 (0.021)	−0.043 (0.021)	−0.005 (0.020)	−0.013 (0.021)	−0.027 (0.021)
Technological beliefs	−0.006 (0.026)	0.029 (0.026)	0.013 (0.026)	0.039 (0.027)	0.001 (0.027)
Trust in science	0.127 (0.068)	0.159* (0.068)	−0.044 (0.068)	0.153* (0.072)	−0.185** (0.069)
Political orientation	0.001 (0.007)	0.000 (0.007)	0.009 (0.007)	−0.024** (0.008)	0.007 (0.007)
Concern_ environment	−0.041 (0.032)	−0.042 (0.032)	0.023 (0.032)	0.010 (0.033)	−0.054 (0.032)
Concern_health	0.040 (0.034)	−0.044 (0.034)	−0.030 (0.034)	0.003 (0.035)	0.031 (0.034)
Concern_animal welfare	0.019 (0.030)	0.038 (0.030)	−0.005 (0.029)	0.028 (0.031)	0.017 (0.030)
Concern_prices	−0.061 (0.033)	0.076* (0.034)	−0.007 (0.033)	−0.005 (0.035)	−0.013 (0.034)
Cut 1	−1.316 (0.469)	−0.929 (0.456)	−1.169 (0.458)	1.977 (0.489)	−0.427 (0.471)
Cut 2	0.513 (0.468)	0.802 (0.456)	0.305 (0.457)	0.560 (0.486)	1.438 (0.473)
Observations	1767	1767	1767	1767	1767
Pseudo R2	0.0053	0.0082	0.0038	0.0172	

(continued)

Table 6 (continued)

	(1)	(2)	(3)	(4)	(5)
β(North-West) = β(North-East)	0.241 (0.132)	0.239 (0.133)	0.106 (0.131)	0.525** (0.138)	0.115 (0.135)
β(North-West) = β(Center)	−0.012 (0.132)	−0.031 (0.132)	0.232 (0.132)	0.238 (0.139)	0.141 0.136
β(North-East) = β(Center)	−0.253 (0.141)	−0.271 (0.141)	0.126 (0.141)	−0.288 (0.148)	0.026 0.146

Last rows show *lincom* (linear combinations of parameters) test of equality of coefficients
**p < 0.01; *p < 0.05; * p < 0.1

the NW to perceive cell-based meat as more in line with tradition, beneficial for the environment and safer for health than insect-based products.

6 Propensity to Accept Cell-Based Meat and Insect-Based Foods as Pet Food

Pet owners made up 59% (n = 1242) of our sample. Among them, 57.98% had a dog, 58.62% had a cat, 7.17% had fish, 5.93% turtles/tortoises, 2.90% rabbits, 1.69% hamsters or other rodents, and 3.30% other pets, mainly birds.

We analysed respondents' propensity to feed their pets cell-based meat and insect flour-based products by considering replies to the following questions: "Would you be inclined to give your pet: cell-based meat/products made from insect flour?" with answer options: "absolutely not", "more no than yes", "more yes than no", "absolutely yes".

When we aggregated responses "absolutely not" and "more no than yes", we found that 72.14% and 72.79% of respondents were not willing to accept cell-based meat or insect flour-based products, respectively, as pet food (44.04% and 46.62% of responses being "absolutely not", respectively) (Fig. 4).

Table 7 shows the results of OLS analysis of determinants of willingness to feed pets the two novel foods. The OLS estimate is specified by Eq. (1).

We found that females, older individuals, those with right-wing political orientations and those living in southern Italy were less willing to use cell-based meat and insect-based products as pet food than non-females, younger individuals, those with left-wing political orientations, and those living in NW Italy. Additionally, concerns about the rising prices of food and basic necessities reduced the propensity to accept either product as pet food. An interesting difference regarding the two novel foods concerned the role of technology and related aspects. While trust in science and technology positively affected the propensity to accept both cell-based meat and insect flour-based products as pet food, positive technological beliefs about the role of science and technology in making our lives healthier, easier and more comfortable positively affected the former but had no impact on the latter.

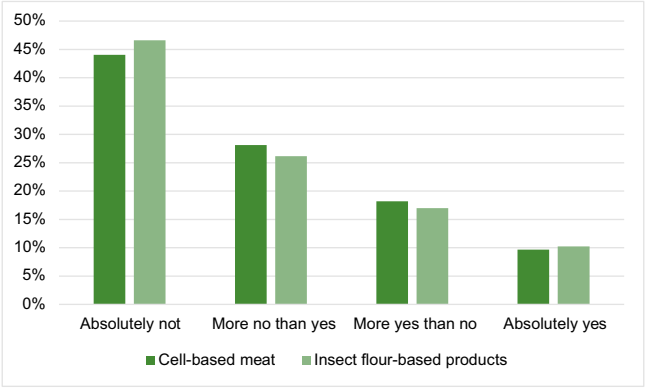

Fig. 4 Propensity to feed pets cell-based meat and insect-flour-based products

Table 7 The determinants of accepting novel foods for pet food

	(1)	(2)
	Pet food with cell-based meat	Pet food with insect-based ingredients
Method	OLS	OLS
Female	−0.127* (0.057)	−0.148* (0.060)
Age	−0.012** (0.002)	−0.011** (0.002)
Parent	0.002 (0.067)	−0.053 (0.071)
Graduate	0.105 (0.061)	0.076 (0.064)
Financial condition	−0.026 (0.051)	0.042 (0.054)
North-West	0.221** (0.074)	0.170* (0.078)
North-East	0.100 (0.078)	0.090 (0.083)
Centre	0.131 (0.078)	0.118 (0.082)
Risk attitude	0.015 (0.012)	0.005 (0.013)
Patience	0.001 (0.013)	−0.001 (0.014)
Technological beliefs	0.041* (0.016)	0.020 (0.017)
Trust in science	0.190** (0.042)	0.142** (0.044)

(continued)

Table 7 (continued)

	(1)	(2)
Political orientation	−0.033** (0.005)	−0.027** (0.005)
Concern_environment	0.021 (0.020)	0.062** (0.021)
Concern_health	0.034 (0.021)	0.014 (0.022)
Concern_animal welfare	0.003 (0.019)	−0.034 (0.020)
Concern_prices	−0.072** (0.021)	−0.064** (0.022)
Constant	1.925** (0.283)	2.094** (0.300)
Observations	1082	1082
Adj R-squared	0.1801	0.1309
β(North-West) = β(North-East)	0.121 (0.082)	0.080 (0.087)
β(North-West) = β(Center)	0.090 (0.082)	0.052 (0.087)
β(North-East) = β(Center)	−0.030 (0.086)	−0.028 (0.091)

Last rows show *lincom* (linear combinations of parameters) test of equality of coefficients
**p < 0.01; *p < 0.05; *p < 0.1

7 Discussion and Conclusions

This chapter aimed to explore acceptance of cell-based meat and insect-flour-based foods by investigating consumers' intentions for human nutrition and feeding pets. We analysed their perceptions with regard to health/safety, environmental impact, animal welfare, consistency with local traditions and disgust, and by directly comparing respondents' perceptions about the two foods.

Our findings can be summarized in different ways. In terms of consumption intentions, the great majority of respondents were reluctant to consume cell-based meat and insect-flour-based foods, favouring the former. We found further support for a role of socio-demographic factors, like age, gender, education and political orientation as drivers of acceptance, and new evidence that acceptance of insect-based products was lower for parents and risk-averse individuals. An interesting finding regarded technological beliefs and trust in science, which positively affected consumption intentions for cell-based meat, but not for insect-based products. This may suggest that cell-based meat is perceived as a more technological product than foods made from insect flour, so that its consumption is favoured by positive beliefs that science and technology make our lives healthier, easier and more comfortable and by greater trust in science and research.

In terms of responder perceptions, we found that those regarding health/safety, environmental effects, animal welfare and taste were more favorable to cell-based meat than insect-based foods. Consistency with tradition emerged as higher for cell-based meat than for insect-flour-based products.

Regarding the determinants of perceptions of cell-based meat and insect-based foods, we obtained general confirmation that age, being female, having children, living in southern Italy, being concerned about health/food safety and the rising of price of food and basic necessities have a negative effect on acceptance. Conversely, educational level, risk propensity, technological beliefs, trust in science and research, concern for the environment and left-wing political orientation showed a positive effect (Table 9 Appendix summarizes the effects of the different determinants).

Focusing on differences in the perceptions of respondents with respect to the two novel foods, we found that the level of trust in science and research positively affected the probability of having a more favourable perception of cell-based meat than insect-flour-based products in terms of environmental effects, consistency with tradition and taste. Age was negatively correlated with the likelihood of perceiving cell-based meat as more in line with tradition, less disgusting and more detrimental for animal welfare than insect-flour-based products. Respondents living in southern Italy were more likely than those in the NW to perceive cell-based meat as more aligned with tradition, beneficial for the environment and safer for health than insect-based products.

Finally, regarding propensity to feed pets with cell-based meat or insect-flour-based products, we found support for lower propensity on the part of female, older and right-wing respondents. Regarding the determinants of propensity to feed pets with the two novel foods, we found an interesting difference that concerned the role of technology and related aspects. In fact, while trust in science and technology positively affected the propensity to feed both cell-based meat and insect-flour-based products to pets, positive technological beliefs only favoured the former product.

Our analysis confirmed that different factors influenced consumer perceptions of different novel foods, as well as their consumption intentions, in different ways. To support the design of targeted policies, future research should therefore also aim to identify the determinants of acceptance of different novel foods in a comparative perspective.

Our analysis suggests that policies aimed at generating a positive attitude towards science and technology may also have a positive effect on consumption intentions regarding cell-based meat, but not insect-based products.

Appendix: Variable Legend and Descriptive Statistics

Table 8 Descriptive statistics and legend

Name	Description	Full sample n = 2102	Half sample with no information n = 1051
Consumption intentions	Variables ranging from 1 "Completely unlikely" to 6 "Completely likely" based on the questions:		
Consumption intentions—cell-based meat	"If it were commercially available, how likely would you be to consume cell-based meat?"	2.505 (1.513)	2.399 (1.489)
Consumption intentions—insect-based products	"How likely are you to increase your consumption of products made from cricket or locust flour?"	2.177 (1.441)	2.039 (1.368)
Perceptions	Variables ranging from 0 (completely disagree) to 10 (completely agree) depending on the level of agreement with the following statements:		
Safe for health_meat	"Cell-based meat is safe for health"	4.173 (2.865)	4.127 (2.889)
Safe for health_flour	"Insect-based products are safe for health"	3.833 (3.004)	3.750 (3.005)
Beneficial for the environment_meat	"Cell-based meat is beneficial for the environment"	5.063 (3.076)	4.993 (3.095)
Beneficial for the environment_flour	"Insect-based products are beneficial for the environment"	4.378 (3.192)	4.296 (3.193)
Detrimental to animal welfare_meat	"Cell-based meat is detrimental to animal welfare"	4.376 (2.988)	4.340 (2.959)
Detrimental to animal welfare_flour	"Insect-based products are detrimental to animal welfare"	4.627 (3.088)	4.718 (3.084)
Consistent with tradition_meat	"Cell-based meat is consistent with our traditions"	2.999 (3.083)	2.937 (3.055)

(continued)

Table 8 (continued)

Name	Description	Full sample n = 2102	Half sample with no information n = 1051
Consistent with tradition_flour	"Insect-based products are consistent with our traditions"	1.980 (2.771)	1.919 (2.713)
Disgusting_meat	"Does cell-based meat disgust you"	5.939 (3.362)	5.973 (3.369)
Disgusting_flour	"Do insect-based products disgust you"	7.044 (3.396)	7.064 (3.393)
Pet food	Variable ranging from 1 "absolutely not" to 4 "absolutely yes", based on the questions:		
Feeding pets with cell-based meat	"Would you be inclined to give your pet cell-based meat?"	1.935 (1.203) n = 1242	1.906 (0.983) n = 627
Feeding pets with insect-based products	"Would you be inclined to give your pet products made from insect flour?"	1.908 (1.019) n = 1242	1.900 (1.001) n = 627
Age	Age	50.934 (16.602)	50.834 (16.609)
Female	DV = 1 if female.	51.43%	51.38%
Graduate	DV = 1 if the respondent had a university degree or higher qualification	34.82%	34.54%
Parent	DV = 1 if respondent has children	63.27% n = 1843	62.77% n = 924
Financial condition	1 = "Really bad"; 2 = "Barely getting by"; 3 = "Living in an acceptable way"; 4 = "Living in a comfortable way"	2.822 (0.611)	2.794 (0.630)
North-West	DV = 1 if respondents were born in NW Italy	27.12%	27.21%
North-East	DV = 1 if respondents were born in NE Italy	19.98%	19.98%
Centre	DV = 1 if respondents were born in Central Italy	20.03%	19.98%
South and islands	DV = 1 if respondents were born in southern Italy or the islands	32.87%	32.83%

Risk propensity	Variable ranging from 1 to 10 based on the question: "Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please score as follows: 1 means: 'unwilling to take risks' and 10 'fully prepared to take risk'."	4.919 (2.411) n = 2059	4.819 (2.351) n = 1023
Patience	Variable ranging from 1 to 10 based on the question: "Would you describe yourself as impatient or patient? Please score as follows, where 1 means highly impatient and 10 means very patient."	6.658 (2.258) n = 2077	6.570 (2.226) n = 1037
Technological beliefs	Variable ranging from 1 (completely disagree) to 10 (completely agree) depending on the level of agreement with the following statement: "Science and technology are making our lives healthier, easier and more comfortable."	6.842 (1.992) n = 2055	6.630 (1.979) n = 1032
Trust in science and research	Variable ranging from 1 (I do not trust them at all) to 5 (I completely trust them) depending on your reply to the question: "How much do you trust science and research?"	3.886 (0.779) n = 2077	3.898 (0.765) n = 1031
Political orientation	Variable reflecting political orientation on an integer scale (10—0—10) ranging from 1 (10 on the right of the scale) to 21 (10 on the left of the scale) where 10 represented the two extremes of the political spectrum.	10.715 (6.215)	10.904 (6.251)
Concerns	Variable ranging from 1 (not worried at all) to 10 (completely worried) in relation to level of concern about:		
Concern_environment	Environmental issues	7.865 (1.980)	7.849 (1.985)
Concern_health	Health problems related to food	7.939 (1.781)	7.934 (1.812)
Concern_animal welfare	Animal welfare	7.484 (2.034)	7.514 (2.041)
Concern_prices	Rising prices of food and basic necessities	8.302 (1.680)	8.326 (1.684)

Note: Standard deviations in brackets. Number of observations shown when different from the maximum
DV dummy variable

Table 9 Determinants of perceptions of cell-based meat and insect-based foods [a]

Factor	Safe for health	Beneficial for environment	Detrimental to animal welfare	Consistent with tradition	Disgusting
Female	−,−	,−	+,		+,+
Older	−,−	−,−		−,−	+,
Parent	−,−				
Graduate	+,+			+,+	−,
Higher risk propensity	+,+	+,+		+,+	,−
Patience		−,	+,+		,+
Positive technological beliefs	+,+	+,+		+,	+,
Trust in science	+,+	+,+	−,−		
Left-wing orientation	+,+	+,+	−,−	+,+	−,−
Southern Italy vs. NW (and/or NE or Centre)	−,−	−,−	+,−	−,	,+
Centre vs. NW			,+		,+
NE vs NW				−,	
Environmental concerns	+,+	+,+	−,−		−,+
Health/safety concerns	−,−				+,
Animal welfare concerns	−,	+,	+,+	+,	
Rising food prices	−,−	−,−		−,−	+,+

a + and − before and after the comma refer to perception regarding cell-meat and insect-based foods, respectively

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