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Yes, it is Insects: Psychological and Sensory Determinants of Consumer Responses to Insect-Based Pasta

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Abstract

The ecological issues associated with traditional farming practices underscore the need for creative alternatives that can reliably meet food demand while reducing environmental impact. Currently, insect-based food production offers a sustainable alternative to traditional livestock farming due to their minimal resource requirements and lower greenhouse gas emissions. However, the success of such alternatives depends not only on their sustainability but also on consumer willingness to accept them. To enrich the existing literature on consumer acceptance of insect-based foods, this study aimed to identify the key psychological and sensory factors influencing consumer attitudes and behaviors, using a structured questionnaire administered to a sample of 755 Italian consumers. The results showed that expected taste is the main driver of desire to eat insect-based products. Perceived healthiness also increases willingness to try, while perceived risk and food neophobia reduce interest in these products. The results provide useful insights into the factors that drive positive attitudes toward entomophagy and the psychological barriers that influence consumer choice. In particular, presenting insect-based foods in ways that emphasize their taste appeal could be fundamental in promoting their consumption. Moreover, addressing safety concerns and educating consumers on the nutritional and environmental benefits of the product reduces adoption resistance based on food neophobia.

Keywords – Insect-based Food; Consumer Acceptance; Food Neophobia; Risk; Expected Taste.

Paper type – Academic Research Paper

Sommario

Sì, sono insetti: fattori psicologici e sensoriali alla base delle risposte dei consumatori sulla pasta a base di insetti – Le problematiche ecologiche legate alle pratiche agricole tradizionali evidenziano la necessità di soluzioni creative in grado di soddisfare in modo efficace la domanda alimentare, riducendo al contempo l'impatto ambientale. Attualmente, la produzione alimentare a base di insetti rappresenta un'alternativa sostenibile all'allevamento tradizionale, grazie al limitato fabbisogno di risorse e alle minori emissioni di gas serra. Tuttavia, il successo di tali alternative dipende non solo dalla loro sostenibilità, ma anche dalla disponibilità dei consumatori ad accettarle. Per arricchire la letteratura esistente sull'accettazione dei cibi a base di insetti da parte dei consumatori, questo studio si propone di individuare i principali fattori psicologici e sensoriali che influenzano atteggiamenti e comportamenti dei consumatori, attraverso un questionario strutturato somministrato a un campione di 755 consumatori italiani. I risultati mostrano che il gusto atteso è il principale fattore che determina il desiderio di consumare prodotti a base di insetti. Anche la percezione di salubrità aumenta la disponibilità a provarli, mentre la percezione del rischio e la neofobia alimentare riducono l'interesse verso questi prodotti. I risultati offrono indicazioni utili sui fattori che favoriscono atteggiamenti positivi nei confronti dell'entomofagia e sulle barriere psicologiche che influenzano le scelte dei consumatori. In particolare, presentare i cibi a base di insetti in modi che ne evidenzino l'attrattiva gustativa potrebbe essere fondamentale per promuoverne il consumo. Inoltre, affrontare le preoccupazioni legate alla sicurezza e informare i consumatori sui benefici nutrizionali e ambientali del prodotto contribuisce a ridurre la resistenza legata alla neofobia alimentare.

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1 Introduction

In recent years, the consumption of insects has become an increasingly discussed topic for the future of the global food system. As the global population continues to rise, projected to reach nearly 10 billion by 2050 (Gu et al., 2021), leading to a consequent increase in food demand (Van Dijk, Morley, Rau, & Saghai, 2021), the need for sustainable and efficient food production methods has never been more urgent. A key factor responsible for resource depletion and environmental degradation is represented by conventional agriculture methods which rely on significant water and soil use, fossil fuel consumption and monocropping practices (Carlsen, 2024; Foley et al., 2011; Tilman et al., 2001; Woods, Williams, Hughes, Black, & Murphy, 2010). Numerous studies have shown that existing farming techniques are unsustainable, underscoring the need for creative alternatives that may reliably provide food demands while having a lower environmental impact (Garnett et al., 2013; Searchinger et al., 2019; Steffen et al., 2015). To this regard, insect farming has been pointed out as an interesting and viable solution to these issues (Bless, Bastian, Gould, Yang, & Wilkinson, 2024).

Recent literature showed that insects offer a sustainable source of protein that can help diversify and improve a less environmentally degrading food production thanks to their high rates of reproduction, quick development cycles and ability to be raised in both urban and rural environments (Specht, Zoll, Schümann, Bela, Kachel, & Robischon, 2019; Verner et al., 2021). In particular, insect farming requires significantly fewer resources compared to traditional food production, with minimal land use, water consumption, and greenhouse gas emissions thus providing a compelling alternative option for food production (Van Huis, 2013; Van Huis, 2020; Van Huis & Oonincx, 2017). In contrast, livestock farming is known for its substantial contributions to greenhouse gas emissions, deforestation, loss of biodiversity, and water resource depletion (Abbasi & Abbasi, 2016; Henchion, Hayes, Mullen, Fenelon, & Tiwari, 2017; Van Huis & Oonincx, 2017). For example, producing one gram of cricket protein requires approximately 23 liters of water, a stark reduction compared to the 112 liters needed to produce the same amount of beef protein (Miglietta, De Leo, Ruberti, & Massari, 2015). Moreover, the crude protein content of edible insects exceeds that of both animal and plant protein sources (Hasnan, Feng, Sun, Parraga, Schwarz, & Zarei, 2023; Pereira & Vicente, 2013). Insects are also rich in essential amino acids, omega-3 and omega-6 fatty acids, iron, zinc, and dietary fiber, positioning them as a nutritionally valuable food source (Nowakowski, Miller, Miller, Xiao, & Wu, 2022). Lastly, 80% of an insect's body weight is edible, which is double that of cattle (Nakagaki & Defoliart, 1991). Another key factor to consider is the versatility of insect-based foods which further highlights their potential for a more widespread adoption. In fact, insects can be processed into powders or pastes for incorporation into a diverse range of food products, from snacks and protein bars to more traditional dishes like pasta

(Melgar-Lalanne, Hernández-Álvarez, & Salinas-Castro, 2019). Based on these evidence, one can confidently suggest that increasing the consumption of insects in global diets could significantly help in reducing the negative environmental impact of traditional farming while also improving the nutritional security of communities (Van Huis, 2013).

Currently, insect consumption is a common practice for at least 2 billion people across 128 countries (Omuse et al., 2024; Tang et al., 2019) with more than 2.000 edible species worldwide (Henchion, Hayes, Mullen, Fenelon, & Tiwari, 2017). Insect-eating traditions are deeply embedded in Asia, Africa, and Latin America populations for centuries (Florença et al., 2022; Henchion, Hayes, Mullen, Fenelon, & Tiwari, 2017), as they represent a perfect nutritious and sustainable alternative to traditional food sources (Costa-Neto, 2015; Smith, Stull, Patz, & Myers, 2021). On the contrary, in many Western countries, the concept of eating insects or insects-based products is often met with skepticism or outright rejection, largely due to the perception of such products as not being part of cultural traditions (Herbert & Beacom, 2021; Raheem et al., 2019) or because of food neophobia (the fear of trying new foods) and feelings of disgust (Wendin & Nyberg, 2021). The factors mainly identified as contributing to the disgust toward insects are varied, encompassing their sensory properties such as texture, as well as the perception of potential harm and the societal stigma to consuming insects (Ardoin & Prinyawiatkul, 2021).

Although not all consumers are willing to embrace insect-based food (Puteri, Oehlmann, & Jahnke, 2024; Sogari, Menozzi, Hartmann, & Mora, 2019), in recent years the environmental advantages of entomophagy have received more attention. Producers are particularly focused on developing products based both on the mere use of simple raw materials (e.g., dried whole insects) and on more sophisticated foods items (such as protein bars, crackers, bread) (Melgar-Lalanne, Hernández-Álvarez, & Salinas-Castro, 2019), and regulations have been supporting their integration in European countries (Mancini, Sogari, Espinosa Diaz, Menozzi, Paci, & Moruzzo, 2022; Papastavropoulou, Xiao, & Proestos, 2023). The European Food Safety Authority (EFSA) has taken steps to regulate the introduction of insects into the food market under its “novel food” framework, which comprises products with no significant history of consumption in the European Union prior to May 15, 1997. These regulations aim to ensure consumer protection while fostering innovation in the food industry by requiring rigorous safety assessments for such insect-based products attempting to spread their presence in European diets.

In view of the intricacy of insect food consumption decisions, investigating the psychological and sensorial factors underlying such decisions is a crucial area of study beneficial for the academic, industrial and retail segments. To address this issue, an empirical research was carried out to assess both positive and negative factors which could influence consumers' attitudes and aversion toward

insect-based pasta. The proposed structural model has been developed to encompass several key dimensions that can encourage or hinder the consumer behavior toward food, which are integrated into a flow of causal relationships: product perceived healthiness and quality, expected taste, food neophobia, perceived risk, desire to eat, and purchase intention.

The risk associated with the consumption of a specific food, as well as the aversion to novel foods, have been pivotal elements in numerous studies that have sought to identify which variables influence behaviors related to food consumption. Food neophobia, a personality trait, manifests as an unwillingness to consume unfamiliar foods, consequently decreasing one's desire for them. (Demattè, Endrizzi, & Gasperi, 2014; Dovey, Staples, Gibson, & Halford, 2008; Stoica & Alexe, 2016). Neophobia has several implications for dietary diversity and nutrition as it restricts the adoption of new food sources, thus limiting the range of nutrients in the diet (Cooke, Wardle, & Gibson, 2003; Galloway, Lee, & Birch, 2003; Lafraire, Rioux, Giboreau, & Picard, 2016; Siegrist, Hartmann, & Keller, 2013). This tendency of neophobic consumers to exhibit negative attitudes and less pleasure in relation to new products (Barrena & Sánchez, 2013), can also be observed in the case of insect-based foods (Padulo, Carlucci, Balsamo, & Fairfield, 2022); high food neophobia can decrease an individual willingness to consume these products as they challenge traditional eating patterns and make it harder for consumers to accept them. Similarly, consumers could be generally less inclined to purchase insect-based products when they perceive them as linked to health or contamination risks. In other words, higher levels of perceived risk are expected to deter consumers from purchasing insect-based products. Perceived risk is a cognitive process that has attracted significant attention due to the crucial role it plays in different contexts, including the purchase decision-making context (e.g., Hunter-Jones, Jeffs, Smith, 2008; Kwun & Oh, 2004; Pillai, Kim, Haldorai, & Kim, 2022; Stone & Grønhaug, 1993). The existing literature has demonstrated that the association of a product with a high risk of poor quality or healthiness can, in fact, exert a negative influence on individuals' purchasing behavior (e.g., Bhukya & Singh, 2015; Hornibrook, McCarthy, & Fearne, 2005; Nguyen, 2019). Considering these reasonings, it is hypothesized that food neophobia and the risk associated with insect-based foods act as deterrents to the consumption of such foods. Moreover, a direct relationship between neophobia and risk is expected: the greater the general aversion to trying new or unfamiliar foods, the greater the perception that new products such as those based on insect flour generate tension and concern, which in turn results in a greater attribution of risk. More formally, the following hypotheses are formulated:

- H1. Perceived risk toward insect-based foods negatively impacts purchase intention.
- H2. Food neophobia negatively impacts the desire to eat insect-based foods.
- H3. Food neophobia increases perceived risk toward insect-based foods.

The other set of antecedents of behavioral intention toward insect flour-based foods concerns the consumers' judgment of quality, healthiness and taste of these products.

Perceived quality measures the consumer's assessment of the overall excellence or superiority of a product (Anselmsson, Johansson, & Persson, 2007; Grunert, 2005; Zeithaml, 1988). Literature has highlighted that the quality expectation associated with different alternatives of a product is an important factor in the choice process, which positively influences purchase intention and customer satisfaction (e.g., Narasimhan & Sen, 1992; Saleem, Ghafar, Ibrahim, Yousuf, & Ahmed, 2015; Steenkamp & Van Trijp, 1996; Tsiotsou, 2006). On the contrary, a negative relationship has been observed between perceived product quality and perceived risk (Beneke, Flynn, Greig, & Mukaiwa, 2013). In light of these considerations, if a high perception of risk associated with the use of a new food product reduces the purchase intention, perceived quality may work in the opposite direction, favoring the choice process. Therefore, it is expected that a higher perceived quality of insect-based products will lead to greater interest and consumption intention, positively influencing consumers' willingness to try them. On the contrary, higher judgments of product quality are expected to lower the risk consumers associate with consumption.

H4. Perceived quality positively impacts the desire to eat insect-based products.

H5. Perceived quality negatively impacts perceived risk with regard insect-based foods.

Perceived healthiness underlies the idea that a product offers nutritional advantages promoting the general well-being (Howlett, Burton, Bates, & Huggins, 2009; Plasek, Lakner, & Temesi, 2020). It has a significant impact on consumer acceptance (de Mello Marsola, de Carvalho Ferreira, Medina, & da Cunha, 2025; Lähteenmäki et al., 2010; Temesi, Bacsó, Grunert, & Lakner, 2019): foods that are perceived to make a positive contribution to health are expected to reduce the sense of risk associated with their consumption. Consequently, when consumers perceive a product as healthy, they are more likely to express an interest in trying it. For instance, insect-based foods, which are rich in protein, vitamins, and minerals, and low in saturated fat, may reduce risk perceptions if they are seen as a healthy alternative to other traditional animal protein sources. A study from Hartmann and Siegrist (2016) suggested that the perception of nutritional benefits of insect-based foods may encourage health-conscious individuals to try them. In the present study, it is expected that higher judgments of the healthiness of insect-based foods will reduce consumers' risk perceptions and increase their propensity to try these products. Therefore, the following hypotheses are proposed:

H6. Perceived healthiness reduces perceived risk toward insect-based foods.

H7. Perceived healthiness positively impacts the desire to eat insect-based foods.

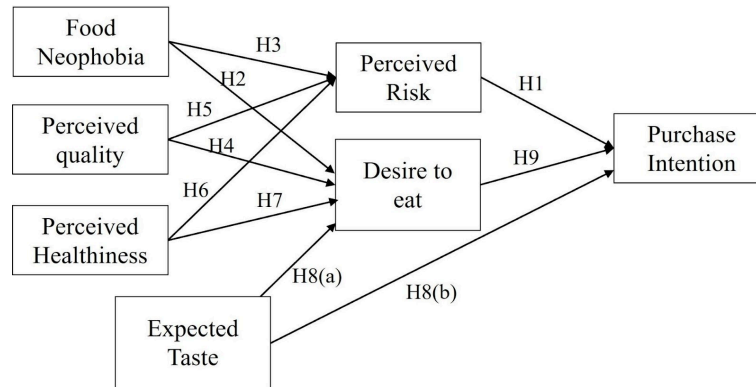
Food expected taste is defined as a sensory attribute that incorporates the chemical senses of taste and olfaction, as well as the oral perception of texture (Drewnowski, 1987; Moskowitz, 1978). Previous research has suggested that sensory expectation exerts a significant influence on food choices (Chen & Antonelli, 2020; Clark, 1998; Drewnowski, 1997; Li, Wang, Ruan, Pan, & Huang, 2024; Piqueras-Fiszman & Spence, 2015). For instance, Paakki, Kantola, Junkkari, Arjanne, Luomala, and Hopia (2022) and Raghunathan, Naylor, and Hoyer (2006) demonstrated that consumers having a strong “unhealthy = tasty” belief are less likely to choose healthy food. This association between taste expectation and consumption decisions is expected to be particularly important when investigating novel products such as insect-based foods, where preconceived ideas about flavor and texture can greatly influence the willingness to purchase and try such products (Halonen, Uusitalo, Levänen, Sillman, Leppäkoski, & Claudelin, 2022; Kane & Dermiki, 2021). Consequently, the next hypothesis assumes a direct and positive relationship between taste expectation and purchasing and consumption intention.

H8. A better taste expectation of insect-based foods has a positive impact on both (a) the desire to eat the product and (b) purchase intention.

Finally, a direct relationship has been hypothesized between the desire to taste the product and the intention to purchase. Motivation and curiosity often drive consumers to buy the products they are interested in (Ajzen, 1991) thus enthusiasm for trying insect-based foods may signal openness to incorporate them into purchasing habits. Therefore, it is expected that when consumers express a strong willingness to try insect-based foods, they are more likely to buy them.

H9. The desire to eat the product positively influences purchase intention toward insect-based foods.

The proposed theoretical model is illustrated in Figure 1.

Figure 1 – Conceptual model and research hypotheses

Source: Authors' elaboration

2 Methodology

The empirical analysis is based on a structured questionnaire administered to a sample of Italian consumers who do not adhere to a vegan or vegetarian diet and with no prior experience with insect-based foods. The interest in this country is motivated by the fact that, although the EU has approved the sale of insects for human consumption, nowhere in Europe is there more resistance to eating insects than in Italy (PanoramItalia, 2023).

The survey was created using the Google Forms platform and launched in May 2024. Respondents were recruited through an informative post on selected social network accounts and instant messaging platforms such as Facebook, Instagram, and WhatsApp. A total of 755 consumers were reached (62% female, 38% male; mean age = 32; age range = 18 – 86). The majority of individuals are graduates (56%), 37% have a high school diploma while 7% attended primary and secondary schools. Informed consent was obtained in accordance with ethical standards set out by the Declaration of Helsinki and with the guidelines for scientific research of the authors' University. After giving their consent to the study, participants were first shown a package of pasta made with insect flour. In order to reduce potential bias due to brand familiarity, an unbranded packaging design was employed. A claim indicating that the product was made of insect flour was added to the other front-of-pack elements, namely, type of pasta, cooking time and weight. After viewing the image for a self-determined amount of time, respondents were asked to answer the questionnaire by referring to the observed product.

The latent variables in the model were measured using scales that have been developed and validated in the literature and have been partially adapted to align with the objectives of the study. Food

neophobia was measured using the 10-item scale by Pliner and Hobden (1992). For detecting perceived healthiness and perceived quality the scales developed by Steptoe, Pollard, and Wardle (1995) and Kulikovski, Agolli and Grougiou (2011), respectively, were employed. Perceived risk was measured through the four items developed by Keh and Pang (2012), while the desire to eat through the 3-item scale of La Barbera, Verneau, Videbæk, Amato, and Grunert (2020). Finally, expected taste and purchase intention were investigated using the items proposed by Raghunathan, Naylor, and Hoyer (2006) and Van Rompay, Fransen, and Borgelink (2013), respectively. All statements were presented on a 7-point anchored scale (from 1 = “completely disagree”, to 7 = “completely agree”, except for *expected taste* scale which ranged from 1 = “not at all”, to 7 = “very much”).

To mitigate potential common method variance (CMV) associated with the use of self-reported measures, several procedural remedies were implemented during the questionnaire design phase. Firstly, an introductory message was used to assure respondents of the anonymity and confidentiality of the study (Chang, Van Witteloostuijn, & Eden, 2010). Secondly, questions were carefully designed to promote clarity and enhance respondents’ understanding (Podsakoff, MacKenzie, Lee, Podsakoff, 2003). Thirdly, following the suggestion by Chang, Van Witteloostuijn, and Eden (2010), the order of some items was randomized to prevent interviewees from perceiving the detailed content of each construct.

The analysis was conducted in two stages. First, confirmatory factor analysis (CFA) was used to examine the validity and reliability of the constructs by estimating the measurement model. Second, the paths of relationships among the latent variables were explored. For the analysis of the measurement model and the conceptual model, structural equation modelling (SEM) was carried out using the LISREL software (release 8.80).

3 Results

3.1 Test of the measurement model

As the normality assumption was violated, according to the skew and kurtosis statistics, the measurement model was estimated using the Satorra-Bentler method (Satorra & Bentler, 1994). The analysis revealed that all items exhibited strong and significant factor loadings, except for two items of the food neophobia “ethnic food seems too strange to eat”, “I’m very particular about what I eat”) that negatively contributed to the validity of the scale. The Average Variance Extracted value ($AVE = 0.394$) did not exceed the acceptability thresholds for construct’s validity and discriminant validity and the

model fit indices were not satisfactory. Consequently, the two items were removed, and the measurement model was re-estimated.

Table 1 – Items of the questionnaire and validity and reliability indexes

Construct	Items	Authors	AVE	CR
Food neophobia	I am always trying new and different foods (R)	<i>Pliner & Hobden (1992)</i>	0.589	0.853
	I don't trust new foods			
	If I don't know what a food is, I won't try it			
	I like food from other cultures (R)			
	I will try new foods at dinner parties (R)			
	I am afraid of eating things I have never eaten before			
	I will eat almost anything (R)			
Perceived quality	I like to try new ethnic restaurants (R)	<i>Kulikovski, Agolli, & Grougiou (2011)</i>	0.782	0.935
	Insect-based food is high quality			
	I think insect-based products are of higher quality than conventional foods			
	Insect-based foods are less associated with health risks			
Perceived healthiness	I think I get higher quality products with insect-based foods	<i>Steptoe, Pollard, & Wardle (1995)</i>	0.779	0.955
	<i>I think insect food...</i>			
	has lots of vitamins and minerals			
	keeps me healthy			
	is nutritious			
	is rich in protein			
Expected taste	is good for skin/teeth/hair/nails	<i>Raghunathan, Naylor, & Hoyer (2006)</i>	0.862	0.926
	is rich in fibre			
Perceived risk	How tasty do you think this type of pasta would be?	<i>Keh & Pang (2012)</i>	0.801	0.941
	How much do you think you would like to eat this type of pasta?			
	The thought of buying this product makes me feel uncomfortable			
	The thought of buying this product gives me a feeling of unwanted anxiety			
Desire to eat	The thought of buying this product makes me feel tense	<i>La Barbera, Verneau, Videbæk, Amato, & Grunert (2020)</i>	0.901	0.965
	The thought of buying this product worries me a lot			
	I would be curious to try a dish of pasta with insect flour, if cooked well			
	In special circumstances, I could try a dish of pasta made with insect flour			
Purchase intention	At a dinner with friends, I would try new foods made with insect flour	<i>Van Rompay, Fransen, & Borgelink (2013)</i>	0.862	0.949
	I would consider purchasing this product			
	I would recommend this product to friends			
	I would like to try this product			

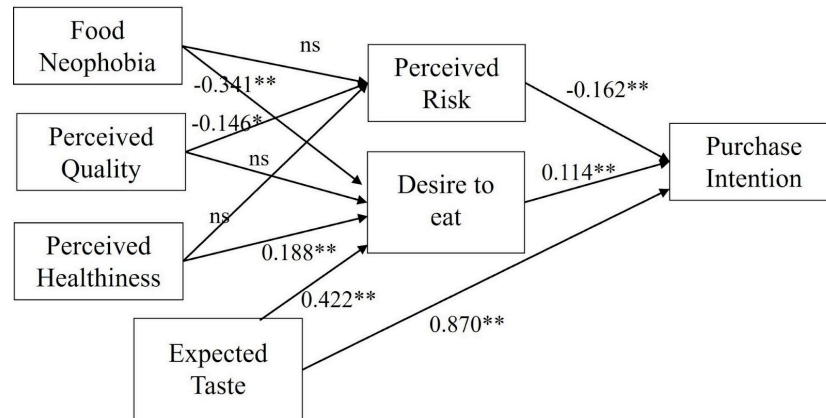
Note. The table reports the validity and reliability indexes, as well as the items, the scales and their authors.

Source: Authors' elaboration

After the removal, the fit of the model was good: $\chi^2 = 2878.749$ (df=384); RMSEA=0.075; NFI=0.973; NNFI=0.975; CFI= 0.978; SRMR=0.090), all constructs exceeded the recommended cut-off points for the adequacy of 0.70 for the Composite Reliability (CR; Steenkamp & Van Trijp, 1996) and 0.50 for the Average Variance Extracted (AVE; Fornell and Larcker, 1981) (Table 1). Finally, accordingly to the Fornell and Larcker's (1981) criterion, the average variance explained by each latent variable was greater than any of the squared correlations involving the variable, thus suggesting that discriminant validity was achieved.

3.2 Test of the structural model

The analysis showed that overall, the structural model fits the data well (Satorra-Bentler $\chi^2 = 2184.545$, df=389; RMSEA=0.078, $p < 0.001$; NFI=0.971; NNFI=0.973; CFI= 0.976; SRMR= 0.103). Considering that fit indices can be affected by effects of violation of normality and independence (Schermelleh-Engel, Moosbrugger, & Müller, 2003), the overall pattern of indices suggests a valid approximation of the model to the data. Results from path coefficients (Figure 2) and t-values indicated that perceived healthiness ($\beta = 0.188$, $p < 0.01$), expected taste ($\beta = 0.422$, $p < 0.01$) and food neophobia ($\beta = -0.341$, $p < 0.01$) were significant drivers of desire to eat insect-based pasta, confirming H2, H7 and H8a. Specifically, while the first two variables had a positive effect on the desire to eat the product, as expected, neophobia acted as a deterrent. Conversely, only the perception of product quality can reduce the attribution of health risks associated with insect consumption ($\beta = -0.146$, $p < 0.05$), supporting H5, while the other antecedent variables had no significant influence on perceived risk. Finally, results confirmed H1, H8b and H9. Expected taste is the variable with the greatest impact on purchase intention ($\beta = 0.870$, $p < 0.01$), which is also mediated by desire to eat. Mediation analysis showed that the indirect effect of taste on purchase intention was significant (indirect effect: 0.048, CI [0.0249, 0.0740]). Desire to eat also exerted a positive impact on the intention to purchase pasta made with insect flour ($\beta = 0.114$, $p < 0.01$), while perceived risk negatively affects behavioral intention ($\beta = -0.162$, $p < 0.01$). Causal effects hypothesized in H3, H4 and H6 are not supported (see Table 2).

Figure 2 – Structural model with standardized coefficients

Source: Authors' elaboration

Table 2 – Summary of structural relationships with coefficients and status

	Hypothesized relationship	β coefficient (p value)	Status
H1	Perceived risk → Purchase intention	- 0.162 (p < 0.01)	Supported
H2	Food neophobia → Desire to eat	- 0.341 (p < 0.01)	Supported
H3	Food neophobia → Perceived risk	0.046 (n.s.)	Not supported
H4	Perceived quality → Desire to eat	0.066 (n.s.)	Not supported
H5	Perceived quality → Perceived risk	- 0.146 (p < 0.05)	Supported
H6	Perceived healthiness → Perceived risk	- 0.110 (n.s.)	Not supported
H7	Perceived healthiness → Desire to eat	0.188 (p < 0.01)	Supported
H8a	Expected taste → Desire to eat	0.422 (p < 0.01)	Supported
H8b	Expected taste → Purchase intention	0.870 (p < 0.01)	Supported
H9	Desire to eat → Purchase intention	0.114 (p < 0.01)	Supported

Source: Authors' elaboration

4 Discussion and conclusion

The present study was motivated by the following research questions: What psychological barriers hinder the consumption of insect-based foods? What are the factors that encourage it? The increased interest in this issue has been driven by the evidence demonstrating that current agricultural techniques are not sustainable and the consequent urgency to find alternatives that can reliably meet the demand for food while reducing environmental impact.

Although insects consumption is a common practice for millions of people around the world, other consumers are reluctant to include insects as a component of their diet due to cultural and psychological barriers. This study fits into this framework and aims to contribute to the existing body of research on consumer acceptance and interest in insect-based foods.

The results showed that the expected taste is the main driver of both the increased desire to eat insect-based pasta and the intention to purchase it. This demonstrates that predisposition toward the product is largely determined by the positive expectations that are automatically created in individuals before they even taste a food. Concurrently, other variables also play a role in influencing the judgment and interest in insect-based foods. Perceived healthiness increases the desire to taste them, while quality expectations reduce the perception of risk. Finally, food neophobia is confirmed as a deterrent to individual willingness to consume these products. Therefore, aversion to new foods, decreasing one's desire toward them, limits dietary diversity and nutrition. The results provide valuable theoretical and managerial insights by highlighting the positive and negative factors that can influence consumers' food choices and indicating potential avenues for further research.

The first aspect that deserves attention is that taste expectations play a crucial role in consumers' purchasing decisions, as demonstrated by previous research (e.g., Chen & Antonelli, 2020; Clark, 1998; Drewnowski, 1997; Goncikowska, Modlinska, Adamczyk, Altuntaş, Maison, and Pisula 2023; Li, Wang, Ruan, Pan, & Huang, 2024; Piqueras-Fiszman & Spence, 2015). Sensory expectation towards the product act as an important driver of purchase intention and desire to eat, with reference to a staple of Italian food tradition that is pasta. Therefore, it could have a fundamental role in making consumers more familiar with insect-based products and consequently reduce cultural resistance. This means that communication and launch strategies for insect flour-based products must focus on highlighting the similarity with traditional dishes, reducing the idea of a strong change in tastiness. It is important to emphasize the flavor and present both the product sensory features as well as organoleptic characteristics in a context that makes the product itself more appealing. For example, suggesting combinations with dishes or ingredients already known and appreciated in the local culture and emphasize the non-alteration of taste can facilitate acceptance and reduce initial resistance. In addition,

marketing communication must go beyond simple product promotion and serve as an educational tool. Providing clear and detailed information about the nutritional benefits of insect flour, such as their high protein content and sustainable attributes, can help allay any health concerns and overcome prejudice against non-traditional foods (Meng, Li, & Fan, 2024). It is also important to address consumer concerns about food safety by highlighting studies and certifications that demonstrate the absence of risks. Finally, an approach that encourages consumer engagement, such as tasting events or communication campaigns that encourage the sharing of positive experiences, can further strengthen trust and interest in these new products. This not only encourages a change in eating habits but also builds a community of informed and passionate consumers.

Another important aspect to consider is the role of consumer perception of quality and healthiness. These factors have a significant impact on the evaluation of and interest in insect food products: these findings confirm previous studies indicating that perceived quality influences perceived risk (Beneke, Flynn, Greig, & Mukaiwa, 2013) and perceived healthiness influences the desire to eat (Hartmann & Siegrist, 2016). Healthiness evaluation seems to be associated with individual benefits, such as vitamin/protein intake. This could explain its significant impact on the intention to consume the product rather than on risk, intended as a feeling of anxiety or worry towards the product. On the contrary, perceived quality refers to product excellence, such as, production processes and origin of ingredients, enhancing the product's perceived reliability, which significantly reduces the perceived risk towards insect-based food. To facilitate acceptance and encourage trial of such products, it is therefore crucial to actively work on improving the perception of their quality and wholesomeness. This may not only increase the desire to consume them but also help to reduce the perception of risk associated with their use. Several strategies can be implemented such as developing advertising campaigns and institutional initiatives that highlight not only the nutrition benefits of insect-based products, but also their positive impact on the environment. Clearly the communication of these benefits can help build a positive narrative around these foods, making them more attractive to consumers. In addition, communication strategies at the point of sale are of fundamental importance. Packaging, for example, can be a powerful communication tool that can convey implicit meanings and influence purchasing decisions. Investing in packaging design that clearly communicates the nutritional and environmental values of insect-based products is crucial to attract consumers and facilitate their choice when they are actually deciding at the point of sale (Silayoi & Speece, 2007).

Finally, food neophobia appears to be a significant barrier to considering insect-based products as a purchase alternative since it increases the perception of risk. This phenomenon is evident among consumers who show a certain reluctance to try new or unconventional foods, such as insect-based pasta, especially in cultural contexts where such foods are not traditionally accepted. These results

confirm the role of food-neophobia in modulating consumer liking as reported in previous findings examining consumers perception of non-insect based protein-rich products (Fantechi, Contini, & Casini, 2023; Grahl, Strack, Mensching, & Mörlein, 2020). A group of consumers, referred to as “laggards”, tends to remain anchored to their eating habits and can approach these new products only when they become widely available and accepted in the market. On the other hand, early adopters, who are more likely to experiment and embrace innovation, represent a crucial segment for marketing strategies. Not only can these consumers be the first to try insect-based products, but they can also act as ambassadors, becoming an important word-of-mouth channel. Their positive experiences can influence other consumers, reducing the negative perception associated with food neophobia and facilitating greater acceptance.

It is worthwhile for managers and marketers to develop strategies that not only target early adopters but also address the concerns of late adopters. This could include educational campaigns that highlight the nutritional and environmental benefits of these products, as well as ensuring that they are presented in familiar and appealing ways. This is the only way to overcome the barriers of food neophobia and encourage greater market penetration.

In summary, successfully encouraging the consumption of insect flour-based products requires an integrated approach that combines effective communication, strategic marketing and product design in order to build a positive and reassuring perception that can lead to greater consumer acceptance and consumption.

5 Limitation and future research agenda

In addition to literature and managerial contributions, the paper opens the discussion to future research perspectives. Several avenues for future research appear promising that could help improve the acceptance of insect meal products.

First, this study specifically focused on Italian consumers and a specific product rooted in the nation culinary culture, limiting the generalizability of the findings to other cultural settings and food categories. Therefore, these results should be interpreted with specific reference to the country under investigation and cautiously compared to other cultural contexts as well as other insect-based products. As food products are deeply embedded in cultural traditions, these play a crucial role in shaping consumer choice and consumption behaviors. Future research should broaden its scope to include cross-national and cross-category comparisons in order to identify potential cultural differences in the acceptance and perception of insect-based foods.

Second, since expected taste is a key factor in food choice, future research could focus on how taste expectations are shaped by prior experiences, whether through direct consumption or exposure to marketing communications. In this regard, studies could examine the impact of branding, packaging, labelling and product claims on shaping taste expectations and, consequently, consumer willingness to try insect-based foods. In addition, an experimental design including a tasting test would allow the measurement of actual taste perception beyond expected taste, providing a more comprehensive understanding of how sensory experiences influence consumer attitudes and purchase intentions.

Thirdly, food neophobia is a significant barrier to the acceptance of insect-based foods. Future research could focus on this aspect and investigate potential strategies to reduce aversion to novel foods, particularly those made from insect meal. This could include exploring the psychological mechanisms behind disgust, fear and food neophobia, as well as identifying effective interventions to overcome these barriers.

Another important aspect to explore is the effectiveness of communication campaigns to identify the most persuasive messages to encourage consumers and reassure them about the safety and quality of insect-based products. Future research could test different communication approaches to determine which ones generate greater interest and acceptance. Specifically, studies could compare the impact of messages that: (a) emphasize the nutritional benefits of the product, particularly its high protein content and essential nutrients, (b) focus on taste attributes, reassuring consumers about flavor expectations and positive eating experiences, (c) emphasize sustainability benefits, underlining the environmental advantages, such as reduced resource consumption and lower carbon emissions. By comparing these approaches, future research could provide valuable insights for designing more effective marketing communication strategies that enhance consumer acceptance of insect-based products.

Finally, the proposed model in this study could be tested in different market segments to gain a deeper understanding of consumer adoption dynamics. In particular, distinguishing between early and late adopters is crucial, as these groups may have different motivations and barriers that influence their willingness to accept insect-based products. In addition, a consumer segmentation approach could help identify other key target audiences, such as health-conscious consumers, environmentalists or protein-seekers, who may be more inclined to adopt these products.

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