Applied Food Research 6 (2026) 101585

Contents lists available at ScienceDirect

Applied Food Research

journal homepage: www.elsevier.com/locate/afres

Application of *Acheta domesticus* powder in food: impact on sensory, rheological, and functional properties

Mohammad Ammar, Sharon Puleo *, Nicoletta Antonella Miele, Natália Câmara, Rossella Di Monaco

Department of Agricultural Sciences, University of Naples Federico II, Piazza Carlo di Borbone, 80055 Portici, Napoli, Italy

ARTICLE INFO

Keywords:
Sensory evaluation
Acheta domesticus powder
Consumer willingness
House cricket powder
Technological property

ABSTRACT

In recent years, house cricket powder has gained attention in the European market as an innovative food ingredient due to its rich nutritional content and low environmental impact. Crickets are rich in protein, fats, vitamins, and minerals, making them a promising alternative protein source in the food industry. This study reviews 48 studies on the effects of *Acheta domesticus* powder on the sensory, rheological, and functional properties of food products, including meat, pasta, bread, biscuits, cookies, pancakes, snacks, crackers, muffins, and complementary foods like porridge . The studies evaluated substitution levels of cricket powder ranging from 1 % to 75 %. The primary outcomes revealed that substituting with cricket powder increases protein, fat, and micronutrient content while lowering carbohydrate levels and reducing the glycemic index of the products. Despite these benefits, high levels of cricket powder substitution may negatively affect the products' physico-chemical, functional, rheological and sensory properties, thus reducing consumer acceptance. Future research should focus on improving the taste, texture, and overall quality of cricket powder-based foods to enhance consumer acceptance and facilitate broader integration of insect-based ingredients into the food market.

1. Introduction

1.1. Global protein context

Global food systems face increasing pressure to meet the nutritional needs of a rapidly growing population. According to the Food and Agriculture Organization (FAO), the global demand for protein will riseby >50 % by 2050, driven by population growth, urbanization, and rising incomes (FAO, 2021). Conventional protein sources such as livestock, poultry, and fish are highly resource-intensive, contributing significantly to greenhouse gas emissions, land degradation, and water scarcity (Parodi et al., 2021). These sustainability challenges have intensified the search for alternative proteins that are nutritionally valuable, environmentally efficient, and socially acceptable.

In this context, edible insects, particularly the house cricket (*Acheta domesticus*), have emerged as a promising candidate due to their high feed conversion efficiency, a lower ecological footprint, and a nutrient rich profile (Van Huis, 2018; Tarahi et al., 2024). Among edible insects, *Acheta domesticus* powder is increasingly recognized for its commercial significance in the global food industry, being incorporated into bakery products, protein supplements, and other functional foods. Its scalability, nutritional density, and growing market demand make it a key focus for research on sustainable protein alternatives (Amoah et al., 2023; Ververis et al., 2022).

1.2. Nutritional potential of Acheta domesticus

Acheta domesticus, a member of the *Gryllidae* family, originated in Southwest Asia but has spread globally due to its association with human habitats (Hussain et al., 2017). Its nutritional profile is particularly attractive for food applications, as cricket powder is rich in high-quality proteins, essential amino acids, vitamins, minerals, and beneficial fatty acid (Pilco-Romero et al., 2023). This is further illustrated in Table 1, which presents the nutritional composition of *Acheta domesticus* powder, including its energy value, macronutrient distribution, fatty acid profile, and selected micronutrients, highlighting its potential as a sustainable and nutrient-dense protein source. Given its widespread adoption in commercial insect farming and its incorporation into various food systems worldwide, *Acheta domesticus* powder represents one of the most relevant insect-based proteins for addressing global protein security.

* Corresponding author.
E-mail address: sharon.puleo@unina.it (S. Puleo).

https://doi.org/10.1016/j.afres.2025.101585
Received 9 June 2025; Received in revised form 4 December 2025; Accepted 12 December 2025
Available online 13 December 2025
2772-5022/© 2025 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Abbreviations

OFSP	Orange-fleshed sweet potato porridge
DDT	Dough Development Time
DS	Dough Stability
DT	Dough Tenacity
DE	Dough Extensibility
SI	Index of Swelling
WAC	Water Absorption Capacity

Table 1
Nutritional composition for *Acheta domesticus* powder (Boonarsa et al., 2025; Siddiqui et al., 2024; Turck et al., 2024).

Component	Reported Values (per 100 g)
Energy	137.5–463 kcal
Protein	41.8–72.33 g
Total Fat	7.5–35 g
Saturated Fat	3.0–6.2 g
Monounsaturated	3.6 g
Polyunsaturated	6.4 g
Trans Fat	0 g
Carbohydrates	0.1–11.8 g
Sugars	<0.1–0 g
Dietary Fiber	3.9–10.2 g
Cholesterol	450 mg
Salt (NaCl)	0.8–1.09 g
Minerals	
Calcium	73.0–3105.0 mg
Iron (Fe)	4.44–9.1 mg
Zinc	2.18–24.4 mg
Potassium	95.0–1080 mg
Phosphorus	32.4–1806.0 mg
Magnesium	1.51–10.0 mg
Iodine	0.04–2.01 mg
Selenium	0.06–0.08 mg
Vitamins	
Vitamin B12	0.01–19.2 μg
Riboflavin	0.097–4.9 mg
Thiamine	0.04–1.66 mg
Folic Acid	0.142–0.199 mg
Vitamin C	3.0–23.9 mg
Vitamin D	<17.15 mg
Vitamin E	1.32–332.1 mg
Retinol	<0.04 mg

Recent analyses show that *A. domesticus* can contain up to 65–70 % protein by dry weight, with balanced amino acid composition comparable to animal proteins (Kim et al., 2022; Gottardi et al., 2024). Moreover, cricket powder can be incorporated into diverse food matrices without compromising safety while enhancing nutritional density (Arp & Pasini, 2024; Bruttomesso et al., 2024; Mehra et al., 2024; Pasqualin Cavalheiro et al., 2024; Payne et al., 2021). As illustrated in Fig. 1, these applications span multiple food systems, highlighting its versatility. Such features position cricket powder as an innovative ingredient that aligns with global health, sustainability, and food security objectives (Cabral, 2024). While its nutritional profile is promising, potential allergenic risks should also be considered. Proteins in house crickets may cross-react with allergens from crustaceans, molluscs, and dust mites, potentially eliciting IgE-mediated responses in sensitized individuals (De Marchi et al., 2021; Siddiqui et al., 2024; Turck et al., 2024; Wangorsch et al., 2024). Awareness of these risks, along with appropriate labeling, is essential to ensure consumer safety while promoting the inclusion of cricket powder in diverse food matrices.

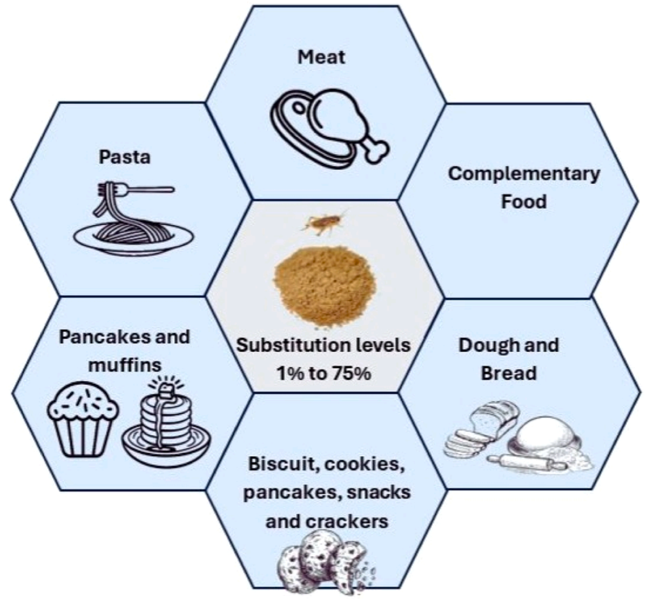

Fig. 1. Application of *Acheta domesticus* Protein Powder as a Partial Substitute in Various Food Products.

1.3. Consumer acceptance of insect-based food

Despite these advantages, consumer acceptance remains one of the major challenges to the widespread adoption of insect-based foods, particularly in Western countries. Low acceptance is often linked to food neophobia (Puleo et al., 2025), cultural perceptions, and sensory-related aversions such as taste, texture, and appearance (Batat & Peter, 2020; Lombardi et al., 2019). However, recent consumer studies suggest that acceptance improves significantly when insects are processed into familiar formats, such as flours, and when products are not explicitly marketed as insect-based Fig. 2 (Lange & Nakamura, 2021; Ribeiro et al., 2024). This highlights the central role of sensory science—which integrates psychology, physiology, and food science—in shaping consumer preferences and guiding product development (Sharif et al., 2017). By optimizing sensory attributes such as flavor, color, and texture (Puleo et al., 2021a,2021b), it is possible to reduce consumer resistance and enhance the market viability of insect-based products (Cruz-López & Escalona-Buendía, 2024; Orkusz et al., 2024).

1.4. Functional and technological potential of Acheta domesticus powder

The sensory, rheological, and functional properties of *Acheta domesticus* powder are therefore crucial in determining its potential for successful integration into food products. Previous research has shown that cricket powder can alter the structural properties of food matrices, affecting viscosity, elasticity, and water absorption (Sereda et al., 2024; Liu et al., 2022). At the same time, its incorporation can enhance protein content, micronutrient density, and antioxidant capacity (Gottardi et al., 2024; Bruttomesso et al., 2024). Understanding these changes is essential for developing formulations that balance nutritional benefits with desirable sensory qualities. Furthermore, with the rising emphasis on sustainable and functional foods, studying these properties contributes not only to scientific knowledge but also to the advancement of environmentally responsible food innovations (Arp & Pasini, 2024; Cabral, 2024).

1.5. Aim of the review

To our knowledge, this review is the first to comprehensively synthesize current findings on the application of *Acheta domesticus* powder

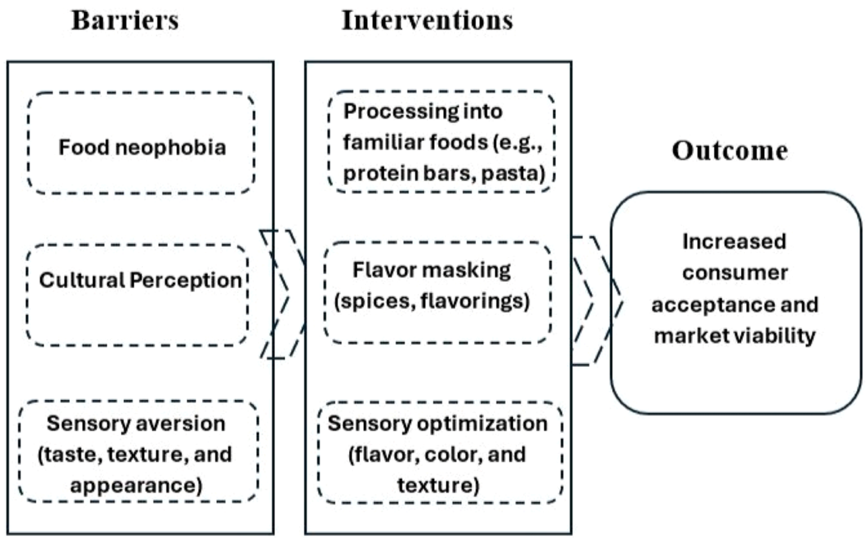

Fig. 2. Factors Influencing Consumer Acceptance of Insect-Based Foods.

across a variety of food products, with a particular focus on its sensory, rheological, and functional characteristics. By critically analyzing both the positive and negative impacts of cricket powder incorporation, this study provides a foundation for future food innovation and offers insights into overcoming sensory and consumer barriers. In doing so, it contributes to the broader discourse on sustainable protein transitions and the development of resilient food systems for the future. The literature research process is explained in the supplementary file, S1.

2. Selection of the articles

For this review, a comprehensive literature search was conducted across multiple databases, including Google Scholar, PubMed, Scopus, ResearchGate, and Web of Science, covering publications from March 2018 to August 2025. Searches were performed using combinations of keywords such as *Acheta domesticus* powder, cricket powder, sensory evaluation, consumer willingness, and technological properties. To ensure quality and reliability, only peer-reviewed articles published in English were included, while non-peer-reviewed sources were excluded. After screening the initial results, a total of 48 studies met the inclusion criteria. These were subsequently categorized by product type, level of cricket powder substitution, sensory evaluation methods, and key findings related to sensory, rheological, and functional properties (Tables 2–7).

3. Research trends and geographical distribution of Acheta domesticus studies

Acheta domesticus has attracted significant attention as an eco-friendly and nutritionally rich alternative to conventional protein sources. Its potential as a sustainable food ingredient is particularly promising, with wide-ranging applications in both the food and feed industries. However, further research, product development, and einitiatives aimed at enhancing consumer acceptance and strengthening regulatory frameworks remain essential to increase consumers' awareness towards entomophagy. Fig. 3 illustrates the frequency of research articles on the use of *Acheta domesticus* powder as a food ingredient published from March 2018 to August 2025.

The distribution of studies shows that Italy leads in investigating the incorporation of *A. domesticus* powder into different food products, particularly with respect to rheological, and physicochemical properties. Following Italy, Poland and the USA also demonstrate considerable research activity if compared to other countries. By contrast, an analysis of scientific databases indicates a marked scarcity of studies from Asian and African countries, despite the long-standing tradition of insect consumption in these regions. This gap underscores a an important opportunity for future research to focus on incorporating cricket powder into traditional foods and cuisines, developing novel recipes, and evaluating their sensory properties. Such efforts could play a pivotal role in broadeningconsumer awareness and acceptance of entomophagy worldwide.

4. Rheological, technological, physical, and sensory effects of *Acheta domesticus* powder in food

The house cricket is farmed and processed in accordance with Good Manufacturing Practice (GMP) and Hazard Analysis and Critical Control Points (HACCP) principles. Specifically, the production process can be divided into three distinctive parts: farming, harvesting, and post-harvest processing. Moreover, all steps take place in a closed farming system (Turck et al., 2021). For instance, house cricket protein powder color, typically ranges from light to dark brown, reflecting variations in processing techniques and fat content (Turck et al., 2024). Powders subjected to freeze-drying or low-temperature drying generally exhibit a lighter hue, whereas roasting or high-heat treatments produce a darker color due to Maillard reactions and increased pigment concentration; defatted powders, in which lipids have been removed, often appear slightly lighter than whole cricket powder (Umebara et al., 2024; Fröhling et al., 2020), making coloration a reliable indicator of processing conditions and compositional characteristics. A detailed characterization of *Acheta domesticus* powder is therefore essential for its application in food systems. The powder provides 42–72 % protein, essential amino acids, unsaturated fatty acids, chitin-based dietary fiber, and key micronutrients (iron, zinc, B vitamins) (Boonarsa et al., 2025; Siddiqui et al., 2024; Turck et al., 2024; Udomsil et al., 2019), while its physicochemical properties—particle size, solubility, and water/oil-holding capacity—directly influence incorporation into various food matrices (Ayllón-Parra et al., 2025; Cruz-López & Escalona-Buendía, 2024; Stone et al., 2019). As a sustainable, high-protein, *Acheta domesticus* powder can modify the rheological and technological properties of doughs and batters, affecting water absorption, viscoelasticity, and structural integrity depending on the food matrix (Brena-Melendez et al., 2024; Cappelli et al., 2020). In addition, it enhances functional qualities such as emulsification, foaming, and gel formation, which can improve the stability of sauces, dressings, mousses, and processed meats (Dion-Poulin et al., 2020; Kowalczewski et al.,

Table 2
List of studies focusing on the sensory evaluation of meat products.

Product	Cricket powder quantity	Sensory method and number of judges	Evaluated sensory attributes	Sensory scale	Negative effect	Positive effect	Reference
Beef patties	- 5 % - 7.5 % - 10 %	Descriptive analysis and affective methods ***N*** = 16 Partially trained judges	-Appearance - Color - Texture - Taste, - Aroma	- 10 cm structured line intensity 0 " Lowest intensity" to 10 "Highest intensity" **Purchase intention test** "I definitely would not buy" and "I definitely would buy"	↓ Sensory acceptance especially taste, and texture ↑ Bitterness taste ↑ Brownish ↑ Hardness ↑ Shear Force ↓ Beef patties diameter	↑ Protein % And enhance its quality ↓ Cooking loss	Cavalheiro et al. (2024)
Beef burgers	- 5 %	Affective methods ***N*** = 10 Untrained judges	- Redness - Color uniformity -Anomalous colorations - Firmness - Overall acceptability **Olfactory analysis** - Intensity - Fresh meat Odor - Negative aromas - Vegetable and hay Odors - Roasted (nuts) aroma - Overall acceptability	- Five-point hedonic scale	↑ Intensity negative aromas	↓ Negative effect on texture after cooking ↓ Formation of harmful heterocyclic amines (Amino-3,8-dimethylimidazo[4,5-f] quinoxaline) ↓ Lipid (fat) accumulation during digestion ↑ Levels of dipeptides like glutaminyl arginine	Rocchetti et al. (2024)
Cooked Pork Sausage	- 5 % - 7.5 %, - 10 %	Affective methods ***N* = 5** Trained judges	-Appearance - Texture - Taste - Smell - Color	- Five-point hedonic scale (1- dislike extremely; 5 - like extremely)	↑ Hardness ↑ Springiness ↑ Darker color ↑Dry and chewy texture ↓ moisture ↓ Emulsion stability and gel formation	Don't affect water activity and microbiological status	Vlahova-Vangelova et al. (2023)
Cooked poultry meatballs	- 2 % - 4 %	Discriminative methods ***N*** = None specified	- Flavor - Taste - Color	- 1 to 5 scales -Triangular test	↑ Possibility of lipid oxidation in final product after cooking ↑ Dryness and roughness ↓ Sensory acceptance especially the taste ↑ Hardness	↑ pH ↑ Water holding capacity ↑ Plastic strength, and structural strength ↓ Water activity ↓ Cooking loss %	Vlahova-Vangelova et al. (2021)
Cooked sausages	- 8.5 % - 6.4 %	Affective methods ***N* = 68** Untrained judges	- Odor - Texture - Taste	- Five-point scale (1=extremely negative, 5=extremely positive).	↑ Dryness texture ↑ Dark color ↑ Floury texture ↓ Acceptance flavor (liver flavor)	None	Keto et al. (2018)
Dry fermented poultry bars	- 2 % - 4 %	Discriminative method ***N* = 5** Trained judges	- Color - Taste - Flavor -Consistence - Overall view	- Triangular test - 1 to 5 scales	↑ Dark color ↑ Structural and plastic strength ↓ Consumer texture, and flavor acceptance	↑ Protein % ↑ Mineral % ↑ Water holding capacity	Kolev et al. (2022)
Pork Frankfurters	- 2.5 % - 5 % - 7.5	Affective methods ***N*** = 15 Partially trained judges	-Appearance - Color - Texture - Taste - Aroma - General acceptability	- Hedonic scale rating test (a 10-cm structured line scale)	↑ Hardness ↑ Brownish colored appearance ↑ Chewiness ↑ Bitter taste after tasting ↓ Sensory scores of appearance, texture, taste, and aroma	↓ Processing loss ↑ Protein % ↑ Zinc, calcium, and manganese ↑Polyunsaturated fatty acids	Cavalheiro et al. (2023)
Pork sausages	- 1 % - 2.5 % - 5 %	None	None	None	↓ Texture quality and stability of the sausages ↑ Dark color	↑ Protein %	Han et al. (2023)
Pork sausage	- 6.23 %	None	None	None	**Sausages** ↓ Firmness ↓ Cohesiveness ↓ Moisture % ↓ Fat % ↑ Dark color	**Sausages** ↑ Springiness ↑Carbohydrates %	Ho et al. (2022)

Table 3
List of studies focusing on the sensory evaluation of pasta products.

Product	Cricket powder quantity	Sensory method and number of judges	Evaluated sensory attributes	Sensory scale	Negative effect	Positive effect	Reference
Pasta	- 5 % - 10 % −15 %	Affective methods $N = 20$ untrained judges	- Appearance - Color - Flavor - Taste - Texture - Overall rating	- Nine-point hedonic scale 1 (extremely dislike) to 9 (extremely like)	↑ Dark color	↑ Protein % ↓ Carbohydrat % ↑ Fat % ↓ Cooking loss ↑ Pasta overall quality ↑ Consumer acceptance	Duda et al. (2019)
Pasta	- 14 %	None	None	None	↑ Dark color ↑ Cooking loss ↑ Optimal cooking time (min)	↑ Firmness ↑ Absorbed water ↑ protein quantity and quality	Pasini et al. (2022)
Pasta	- 5 % - 10 %	None	None	None	↓ Dough tenacity, and strength ↓ Firmness ↑ Water absorption ↑ Cooking loss	↑ Protein % ↑ Fiber %	Bresciani et al. (2022)
Pasta	- 5 %	None	None	None	↑ Dark color	↑ Protein % ↑ Fat % ↓ Carbohydrate % ↑ Texture property	Ho et al. (2022)
Pasta	- 10 %	None	None	None	None	↑ Nutrtional content ↑ Product stability by decreasing water activity	Indelicato et al. (2025)

2023; Ndiritu et al., 2017; Zielińska, 2022). However, these properties can also introduce challenges, in sensory attributes such as color, texture, and flavor, which directly influence consumer acceptance.

Color is often the first noticed sensory attribute, strongly influencing purchase decisions towards new foods by affecting visual appeal, shaping taste expectations, triggering psychological responses, and carrying cultural associations, all of which contribute to the effectiveness of marketing efforts (Spence, 2018). Cricket powder, depending on species and processing method, typically darkens products, which may reduce appeal compared with lighter controls (Igual et al., 2020; Pambo et al., 2018; Spence, 2015). While darker powders may blend well into certain foods (e.g., chocolate, whole-grain products), they may be less acceptable to neophobic consumers in lighter-colored matrices (Piqueras-Fiszman & Spence, 2014; Cruz-López et al., 2022). Formulation adjustments, natural color additives and improved cooking methods have been suggested to mitigate these effects (Sogari et al., 2019; Spence et al., 2010).

Texture is another key determinant of product acceptability and is strongly affected by the type and concentration of cricket powder used (Biró et al., 2020; Sogari et al., 2019). The unpleasant effects of incorporating insect powder on the texture profile of developed products can be attributed to its impact on techno-functional and rheological properties. Studies have reported that higher substitution levels increase firmness, chewiness, and density, while reducing volume and extensibility in baked goods (Acosta-Estrada et al., 2021; Castro Delgado et al., 2020; Kowalski et al., 2022). The hardness of cookies, for instance, proportionally increases with the level of insect powder substitution, which may be attributed to the high fiber content of certain species (Ortolá et al., 2022). This can negatively impact consumer perception, particularly in products like cookies and bread, where softness and elasticity are expected due to their strong correlation with human perception of freshness. On the other hand, cricket powder's water-binding capacity contributes positively to moisture retention and shelf life, and its proteins improve structural stability in batters and doughs (González et al., 2019; Han et al., 2023; Mugova et al., 2021).

Taste and flavor play a decisive role in consumer willingness to try cricket-based foods. Cricket powder is often described as nutty and earthy, qualities that can complement bakery food, smoothies, and protein bars, while other insect powders may contribute stronger umami or savory notes suitable for soups and sauces. Nonetheless, higher inclusion levels may introduce negative notes such as bitterness, feed-like flavors, or unpleasant aftertastes, limiting consumer acceptance (Alemu & Olsen, 2020).

Taste perception is highly individual, in fact, consumers have varying preferences for the taste of novel foods (Jürkenbeck et al., 2024). It is influenced by genetic sensitivity to bitter compounds as well as cultural dietary preferences (Deshaware & Singhal, 2017; Choi, 2021). Although sensory sensitivity can act as a barrier, strategies such as flavor masking, repeated exposure, and consumer education about nutritional and environmental benefits can help improve acceptance.

Overall, the successful integration of cricket powder requires balancing its nutritional and functional advantages with careful management of sensory properties. By focusing on these properties and aligning them with consumer preferences, the acceptance of edible insect powders can be significantly improved (Mishyna et al., 2020; Saldaña et al., 2024). Furthermore, addressing these sensory properties and consumer perceptions allows food manufacturers to develop and market edible insect powders more effectively, leading to greater consumer acceptance and wider adoption.

Product-specific studies consistently show that moderate substitution levels (<10 %) are most effective for maintaining consumer acceptance, whereas higher levels (>15–20 %) tend to compromise color, texture, and flavor. This balance is central to positioning A. domesticus powder as a viable, sustainable protein source in mainstream food products (Payne et al., 2016).

4.1. Meat

Across meat systems, cricket powder influences both technological and sensory characteristics in ways that vary depending on substitution percentage, fat content, and processing method. Studies such as Cavalheiro et al. (2024) and Vlahova-Vangelova et al. (2021) consistently report improved water- and fat-holding capacity at low–moderate inclusion levels (<7.5 %), resulting in reduced cooking loss and higher product yields. These improvements likely stem from cricket proteins' strong water-binding properties and chitin-associated structural reinforcement. However, as inclusion levels increase, textural changes—such as heightened firmness or chewiness—emerge, reflecting a shift in the balance between protein–protein interactions and matrix hydration.

Sensory evaluations across nine studies (Table 2) highlight that substitution levels below ~4 % tend to enhance or maintain sensory acceptance in patties, sausages, and frankfurters. Above this threshold, consumers frequently report off-flavors described as "livery," "feed-

Table 4
List of studies focusing on the sensory evaluation of bread products.

Product	Cricket powder quantity	Sensory method and number of judges	Evaluated sensory attributes	Sensory scale	Negative effect	Positive effect	Reference
Bread	- 10 % - 30 %	Affective methods ***N*** = 9 Untrained judges	- Taste evaluation (global liking)	- Nine-point hedonic scale 1 (extremely dislike) to 9 (extremely like)	↓ Consistency ↑ Dough development time ↓ Dough stability ↑ Viscosity ↑ Possibility of growth spore forming bacteria	↑ Protein % ↑ Essential amino acids such as tyrosine, valine, methionine, and lysine. ↑ Firmness of loaves	Osimani et al. (2018)
Bread	- 5 % - 10 % - 15 %	Descriptive Methods ***N*** = 6 Trained judges	- Taste - Flavor - Odor	10 cm linear unstructured scale: **Odor, flavor and taste** "None" to "very strong" **Texture** (Adhesiveness, moisture of crumb and hardness of crumb**)** "Low" to "high". **Color** "light" to "dark" **Porosity** "Low porosity" to "high porosity"	↑ Dark color ↑ Hardness ↓ Bread crumb Porosity ↓ Palatability of bread ↓ Intensity of flavor ↑ Intensity of the bitter taste	↑ Protein % ↑ Fatty acids (monounsaturated and polyunsaturated fatty acids) ↑ Vitamins and micronutrients content	Gantner et al. (2024)
Bread	- 10 % - 20 % - 30 %,	Affective methods ***N*** = 42 Untrained judges	-Appearance -Smell -Texture -Taste - Overall acceptability	- Five-point Likert scale	↓ Springiness ↓ Cohesiveness ↑ Gumminess and chewiness with 20 % cricket substitution	↑ Protein % ↓ Hardness ↓Gumminess and chewiness at low substation 10 %	Kowalski et al. (2022)
Bread	- 5 %	None	None	None	↑ Dark color ↑ Dough development time	↑ Proteins % ↑ Fibers % ↑ Dough Stability	González et al. (2019)
Bread	- 10 % - 15 % - 20 % - 25 % - 30 %	Affective methods ***N*** = 30 Untrained judges	- Appearance - Texture - Flavor - Taste - Overall acceptability	- Nine-point hedonic from 1 (dislike extremely) to 9 (like extremely)	↑ Hardness ↑ Chewiness ↓ Springiness ↑ Darker color	↑ Protein % ↑ Fat % ↑ Ash % ↑ Amino acids content ↓Carbohydrate %	Mafu et al. (2022)
Bread	- 5 % - 10 %, - 15 %	None	None	None	↑ Dough tenacity ↓ Dough extensibility ↓ Softness ↓ Bread volume ↑ Deformation energy ↑ Crumb density ↑ Dough development time	↑ Dough stability ↑ Protein %	Cappelli et al. (2020)
Bread	- 5 % - 10 % - 20 %	None	None	None	↓ Extensibility ↓ Loaf volume ↑ Hardness ↑ Dough development time ↑ Dark color	↑ Protein ↑ Dough stability	Perez-Fajardo et al. (2023)
Bread and cookies	- 5 % - 10 % - 15 %	Affective methods ***N*** = 30 Untrained judges	- Color - Appearance - Smell - Taste - Texture - Overall acceptability	- Nine-point hedonic scale 1 (extremely dislike) to 9 (extremely like)	↑ Dark color ↑ Hardness ↓ specific volume (ml/g) ↑ Chewiness ↑ Hardness ↑ Cohesiveness ↑ Springiness	↑ Protein % ↑ Minerals % (iron, and phosphorus) ↓Carbohydrates %	Bawa et al. (2020)
Bread	**Dough, and bread** - 5 % - 10 % - 20 %	None	None	None	**Dough** ↓ Emulsifying activity ↓ Emulsion stability. ↓ Foaming capacity ↓ Gluten ↓ Dough extensibility ↑ Tenacity ↑ Stiffness **Bread** ↑ Dough development time ↓ Loaf volume ↓ Specific volume ↑ Crumb firmness	**Dough** ↑ Foaming stability **Common benefit** ↑ Protein % ↑ Fiber %	Bresciani et al. (2022)
Chapatti (Roti)	- 5 % - 10 % - 15 %	None	None	None	↑ Resistance to extension ↓ Extensibility ↑ Hardness ↑ Dough development time	↑ Dough consistency	Khatun et al. (2021)

(continued on next page)

Table 4 (*continued*)

Product	Cricket powder quantity	Sensory method and number of judges	Evaluated sensory attributes	Sensory scale	Negative effect	Positive effect	Reference
					↑ Water absorption that negatively affects porous structure of the final chapatti product. ↓ Dough stability ↓ Viscosity and setback viscosity, which hinder the starch gelatinization and retrogradation processes in the dough ↓ Dough extensibility ↑ Tenacity		
Flatbread	- 11.6 % - 13.3 %	None	None	None	↑ Dark color	↓ Hardness ↑ Fiber %	Belleggia et al. (2023)
Corn tortillas	- 5 % - 7.5 % - 10 %	None	None	None	↑ Dark color ↑ Torque value ↑ Texture thicker, and viscous ↓ Dough consistency	↓ Glycemic index ↑ Form complexes resistant starch type V (amylose, and lipid) ↑ Protein % digestibility ↑ Fiber %s	Alvarez-Barajas et al. (2023)

like," or "stuffy," alongside textural dryness or darker appearance, which diminish acceptability (Cavalheiro et al., 2024; Cavalheiro et al., 2023; Ho et al., 2022; Keto et al., 2018; Kolev et al., 2022; Rocchetti et al., 2024; Vlahova-Vangelova et al., 2023, 2021). Such patterns align with findings in other matrices, suggesting that while meat systems may better mask cricket flavor compared to starch-based matrices, they remain sensitive to high substitution percentages. Overall, meat applications present strong technological potential due to favorable rheological effects, but require careful optimization to avoid flavor and texture deterioration.

4.2. Pasta

The literature on pasta systems illustrates an important tension between nutritional fortification and structural integrity (Table 3). As reported by Pasini et al. (2022), high water absorption in cricket-enriched pasta stems from hydrophilic amino acids and fiber fractions that promote gel formation. Although this can improve firmness at low levels, studies such as Bresciani et al. (2022) demonstrate that beyond 5–10 % substitution, the gluten network weakens, leading to higher cooking losses and reduced mechanical strength. This phenomenon, echoed across multiple studies (Duda et al., 2019; Ho et al., 2022), highlights that cricket powder acts as both a functional (Indelicato et al. (2025) reported that the inclusion of house cricket flour can enhance the nutritional value of pasta by up to 10 %) and disruptive ingredient.

Sensory acceptance varies widely across consumer groups, with Duda et al. (2019) reporting comparable liking up to 15 % inclusion, while others observe declines at similar levels. These discrepancies can be ascribed to consumer familiarity, cultural expectations, and product format that strongly modulate perceptions. Overall, pasta systems appear more tolerant to cricket inclusion than bread (as comparison with a flour-based product), but still exhibit a threshold—generally around 5–10 %—beyond which quality begins to deteriorate.

4.3. Dough and bread

According to Bresciani et al. (2022), wheat flour generally requires a significant amount of time to develop gluten, the protein network responsible for giving dough its structure and elasticity. This results in a high level of consistency (firmness and cohesiveness), which is crucial for bread making. Such high consistency is characteristic of strong wheat flour, which is renowned for its high gluten content and excellent bread-making properties. However, the incorporation of cricket powder weakens the gluten network. This weakening may be attributed to gluten dilution, where the addition of non-gluten proteins from cricket powder reduces the concentration of gluten-forming proteins, thereby accelerating the aggregation process. Consequently, the time needed to reach maximum consistency (peak maximum time) and the total energy required for dough development both decrease. This suggests that the gluten network forms more rapidly and with less energy, which is consistent with the findings of González et al. (2019). The addition of cricket powder to bread dough, particularly at a 20 % replacement level, negatively affects the bread's volume by reducing dough stretchability and weakening the gluten network, thereby diminishing the dough's ability to retain gas during baking (Bresciani et al., 2022).Besides that, all of the studies found that the substitution of a high percentage of cricket powder (> 10 %) could affect negatively on texture property of bread, which results harder and tougher to chew (Ganter et al., 2024). This effect may be attributed to the properties of the cricket powder, which likely alters the bread's structural integrity. In summary, while most loaves enriched with cricket powder exhibit a firmer and chewier texture, those with <10 % enrichment remain comparable to the control, suggesting that cricket powder can be incorporated up to this level without significantly influencing the bread's texture. This phenomenon may be explained by the water-binding capacity of fiber, which can negatively influence the development of the starch–gluten structure in baked products. By absorbing excessive amounts of water, the fiber reduces the availability of water required for starch gelatinization and gluten network formation, resulting in a harder, less elastic bread with a firmer texture and diminished softness and stretchability (Bawa et al., 2020; Khatun et al., 2021). Also, functional properties of flour, such as foaming capacity, refer to the ability of a substance to generate foam when air is incorporated into a liquid system (Bresciani et al., 2022; Mafu et al., 2022). Indeed,the addition of cricket powder with high substitution to wheat diminishes the foaming capacity, likely because the presence of cricket powder interferes with the wheat proteins' ability to effectively trap air, resulting in less foam formation. This reduction in foaming capacity is attributed to the cricket powder's impact on protein-protein interactions within the system. Generally, proteins must interact to form a robust network capable of trapping air and producing foam. When these interactions are weakened or disrupted, foam production is compromised. Additionally, foaming stability refers to the foam's ability to maintain its structure over time without collapsing. Despite the reduced foaming capacity, the foam that was produced

Table 5
List of studies focusing on the sensory evaluation of biscuits, cookies, corn snacks and crackers products.

Product	Cricket powder quantity	Sensory method and number of judges	Evaluated sensory attributes	Sensory scale	Negative effect	Positive effect	Reference
Biscuits	- 10 % - 15 % - 20 %	Affective methods ***N*** = 72 Untrained judges	- Degree of liking (Taste)	Hedonic scale **top line** “like very much,” the **middle line** “no like nor dislike,” and **the last line** “dislike very much	↑ Possibility to generate Toxic substances at high temperature: 5-Hydroxymethylfurfural, Furfural, and Acrylamide ↓ Spread ratio	↑ Protein % ↑ Fiber % ↓ Glycemic index ↑ Protein and lipid digestibility	Bas and El (2022)
Biscuits	- 10 % - 15 %, - 20 %	Affective methods ***N*** = 100 Untrained judges	-Appearance - Color - Taste - Texture - Aroma - Overall acceptability	- Five-point hedonic scale 1- (dislike extremely); 5- (like extremely)	↑ Intensity of brown color	↑ Protein % , fat %, fiber %, ash % and energy contents ↑ Sensory acceptance (appearance, aroma and overall acceptability) ↑ Mineral % especially (Zn, Fe, Ca & Cu) ↓Carbohydrates %	Duku et al. (2023)
Biscuits	- 10 %	Affective methods ***N*** = 57 Untrained judges	- Looks - Color - Smell - Taste - Texture -Overall acceptability	- Five-point Likert hedonic scale	↑ Dark color	↑ Protein ↑Micronutriments (vitamin B12, iron, zinc and iodine) ↓ Carbohydrates % ↑ Unsaturated fatty acids	Homann et al. (2017)
Oat Biscuit	- 5 % −10 % - 15 %	Affective methods ***N*** = 77 (67 Untrained judges and 10 trained judges)	-Appearance - Odor - Texture - Flavor - Overall liking - Color	- Nine-point hedonic scale 1 (extremely dislike) to 9 (extremely like) - Check-all -that-apply (CATA)	↑ Hardness ↑ Brown color ↓ Reduce flavor acceptance (Burnt flavor) ↑ Titratable Acidity	↑ Protein % ↓Carbohydrates %	Biró et al. (2020)
Whipped flour semi-finished product) Baked round biscuit)	- 5 %, - 10 % - 15 %	None	None	None	↓ Resiliency ↓ Elasticity of the finished product ↓ Sugar %, as it negatively affects the dough’s plasticity ↓ Porosity	↑ Shear stress, which leads to stabilization of the viscosity ↑ Proteins % ↑ Ash % ↓ Caloric content	Sereda et al. (2024)
Biscuits	10 %	Affective methods *N* = 164 Untrained judges	-Appearance -Texture -Taste - Flavor - Aftertaste - Overall liking	- Food Neophobia Scale (FNS) −9-point hedonic scale. - 10cm Linear Scale (0=low intensity. 10=high intensity). -Just-about-right (JAR) scales	↑ Darkness, bitterness, cricket powder flavor, and umami >10 %	↑Sensory acceptance (appearance, texture,and overall liking)	Puleo et al. (2025)
Chocolate brownie	- 7 %	None	None	None	↓ Chewiness ↓Viscoelasticiy	↓Carbohydrates % ↑ Protein %	Ho et al. (2022)
Chocolate Chip Cookies	- 5 % - 7.5 % - 10 %	Affective methods ***N*** = 180 Untrained judges	- Color - Aroma - Flavor -Texture -Overall linking - Purchase Intent (PI) - Consumer Emotional Responses	- Nine-point hedonic scale 1 (extremely dislike) to 9 (extremely like) - yes/no scale - Five-Point Intensity Scale	↑ Dark color ↑ Softness ↑ Dough development time ↓ Dough extensibility ↓ Index of swelling ↑ Deformation energy ↓ Consumer texture, and flavor acceptance	↑ Protein % ↓ Fat % ↓ Carbohydrate % ↑ Dough stability ↑ Water absorption capacity ↑ Foaming capacity ↑ Foaming stability ↑ Protein solubility ↑ Emulsion capacity	Aleman et al. (2022)
Finger millet cookies	- 10 %	Affective methods ***N*** = 30 Trained judges	- Taste, - Aroma, - Color - Texture and mouthfeel	- Five-point hedonic scale	↑ Dark color	↑ Protein % ↑ Mineral % ↑ Fiber % ↓ Moisture % ↑ Overall acceptability	Mwanyigha et al. (2023)
Crackers	- 5 % - 10 % - 15 % - 20 %	Affective methods ***N*** = 150 Untrained judges	- Color - Texture - Flavor - Overall acceptability	- Nine-point hedonic scale 1 (extremely dislike) to 9	↑ Hardness ↑ Darker color	None	R. Ardoin et al. (2021)

(*continued on next page*)

Table 5 (*continued*)

Product	Cricket powder quantity	Sensory method and number of judges	Evaluated sensory attributes	Sensory scale	Negative effect	Positive effect	Reference
				(extremely like) (yes/no scale)			
Crackers	- 5 %	Affective methods ***N*** = 25 Untrained judges	- Overall acceptability -Appearance - Taste - Aroma	- Nine-point hedonic scale 1- (strongly dislike); 9- (very like)	↓ Consumer sensory acceptance (overall acceptability, appearance, taste, and aroma)	↑ Mineral content, particularly zinc and iron ↑ Amino acid composition especially (threonine, alanine, valine, isoleucine, leucine, lysine, phenylalanine, tyrosine, and arginine) ↑ Sensory acceptance (Smell balanced, and pleasant)	Ivanišová et al. (2023)
Crackers	- 0 % - 5 % - 10 % - 15 % - 20 %	Affective methods *N* = 150 Untrained judges	- Color -Texture - Flavor -Overall liking -Overall acceptability-Preference	-Nine-point hedonic scale 1- (strongly dislike); 9- (very like) -(yes/no scale)	↓Overall acceptability >20 % ↓Dough cohesion >20 %	None	Ardoin et al. (2020)
Rice crackers	- 0 % - 10 % - 20 % - 30 %	Affective methods *N* = 73 Untrained judges	-Color -Appearance -Aroma -Texture -Taste -Overall taste	- Nine-point hedonic scale 1- (strongly dislike); 9- (very like)	↓Darkness ↓Appearance acceptability	↑Overall liking, particularly taste and aroma, ≤20 % of cricket powder	Suga et al. (2023)
Corn Snacks	- 2 % - 4 % - 6 % - 8 %	Affective methods ***N*** = 20 Untrained judges	- Shape - Color - Aroma - Taste - Crispness	- Five-point hedonic scale(1- lowest acceptance, and 5- highest acceptance)	↑ Dark color ↓ Expansion ratio > 2 % cricket powder	↑ Consumer acceptance of the texture and mouthfeel of the snacks	Ruszkowska et al. (2022)
Extruded corn snacks	- 5 % - 7.5 % - 10 % - 12.5 % - 15 %	None	None	None	↑ Bulk density ↑ Hardness	↓ Moisture loss, which helps in optimizing the extrusion process ↑ Protein % ↓ Water Solubility Index, which leads to reduce small molecule solubilization during extrusion and potential molecular damage ↓ Expansion index and Porosity, which maintains typical extrudate characteristics	Igual et al. (2020)
protein balls snacks	−7 %	Affective methods *N* = 129 Untrained judges	-Texture -Taste -After-taste -Aroma -Appearance	−7-point Likert scale (1 = Strongly Disagree ;7 = Strongly Agree) -Purchase intention test 0 (will not purchase) and 1 (will purchase)	↓Overall acceptability particularly taste and aroma	↑Protein % ↑Nutritional content	Khalil et al. (2025)
Energy bars and protein bars	- 10 % - 20 %	Affective methods ***N*** = 96 Untrained judges	- Taste - Smell	- 1–5 Likert scale (1- very pleasant, 5- unpleasant)	None	↑ Consumer acceptance and willingness without affecting texture or taste.	Adámek et al. (2018)
Gluten free bars	- 5 % - 10 % - 15 % - 20 % - 25 %	Affective methods ***N*** = 16 Partially trained judges	- Texture - Taste -Appearance - Aroma - Overall acceptability	- Nine-digit categorical ordinal scales	↓ Consumer acceptance for taste and overall pleasantness	↑ Antioxidant activity ↑ Polyphenol %	Pecova et al. (2023)

exhibited increased stability with the inclusion of cricket powder. This stabilization effect highlights how the incorporation of *Acheta domesticus* powder into bread and dough can influence the quality and sensory properties of baked products. Therofere, also in this case, although there is potential for improved protein content and other nutritional benefits, challenges include maintaining desirable texture and flavor. Table 4 summarizes 12 studies on the use of house cricket as an ingredient for bread and its derivatives, such as tortilla, chapatti, and flatbread. Findings from five sensory trials (Table 4) show broad variability in consumer responses, ranging from high acceptance at 20 % inclusion (Gantner et al., 2024) to notable rejection at 10–30 % (Osimani et al., 2018). These inconsistencies underscore the need for standardized

Table 6
List of studies focusing on the sensory evaluation of pancakes and muffins products.

Product	Cricket powder quantity	Sensory method and number of judges	Evaluated sensory attributes	Sensory scale	Negative effect	Positive effect	Reference
Pancakes	- 10 % - 20 % - 30 %	None	None	None	↑ Dark color ↑ Hardness ↑ Chewiness ↓ Cohesiveness ↑ Pore density	↑ Fiber % ↑ Protein % ↑ Fat, mainly polyunsaturated fatty acid ↑ Water Solubility Index	Bruttomesso et al. (2024)
Wheat Pancakes	- 10 % - 20 % - 30 %	Affective methods ***N*** = 60 Untrained judges	- Color - Appearance - Aroma - Flavor - Structure - Preference - Texture	- 10 cm visual unstructured scales - Food Neophobia Scale (FNS)	↑ Dark color ↑ Hardness ↓ Overall acceptability especially flavor Slightly effect on texture, aroma, and appearance	↑ Protein % ↑ Fat % ↑ Fiber %	Mazurek et al. (2022)
Sponge cake	- 5 % - 10 %	Descriptive methods ***N*** = 5 Trained judges	- Appearance - Cell size uniformity - Crumb tenderness - Odor -Taste	- 1 to 5 scales	↓ Moisture % ↓ Water absorbing capacity ↓ Specific gravity Decrease Crumb tenderness ↑ Compactness ↑ Dark color ↓ Springiness ↓ Consumer acceptance	↑ Protein % ↓ Shrinkage, which means, the internal cake's structure more stable	Vlahova-Vangelova et al. (2022)
Muffins	- 5 % - 10 % - 15 %	Affective methods ***N*** = 40 Untrained judges	- Taste - Color - Odor - Texture - Overall acceptability	- Nine-point hedonic scale 1 (extremely dislike) to 9 (extremely like)	↓ Consumer acceptance (color, taste, and flavor) ↓ Muffins Height (cm), and Specific Volume	↑ Protein % ↑ Ash ↑ Fat ↑ Total phenols ↑ Antioxidant activity	Chiș et al. (2022)

sensory protocols and more detailed reporting on particle size, fat content, and powder processing method—all factors likely influencing texture, color, and flavor (Bawa et al., 2020; Gantner et al., 2024; Kowalski et al., 2022; Mafu et al., 2022; Osimani et al., 2018.

4.4. *Biscuits, cookies, pancakes, snacks, and crackers*

Across baked snacks and confectionery systems, cricket powder consistently increases dough resistance and hardness, decreases extensibility, and darkens product color due to intensified Maillard reactions (Bas & El, 2022; Aleman et al., 2022). These effects result in denser, less aerated structures at higher substitution levels, reflecting shifts in protein–starch interactions and increased water binding. However, the functional impact is matrix-dependent: while viscosity and plasticity changes may be detrimental in cookies or crackers, in pancakes, for instance, they may improve structural cohesion at low substitution levels but reduce cohesiveness at 20–30 % (Bruttomesso et al., 2024). Indeed, Aleman et al. (2022) reported an increase in cricket powder substitution in dough, which absorbed slightly more water. This is likely due to the hydrophilic properties of the protein in cricket powder, which attracts and binds water. Additionally, the inclusion of cricket powder led to increases in Dough Development Time (DDT), Dough Stability (DS), and Dough Tenacity (DT), resulting in a stronger dough that requires more time to develop and remains stable for a longer period. However, a decline in Dough Extensibility (DE) and Index of Swelling (SI) was observed, indicating that the dough became less extensible and had a reduced ability to swell when cricket powder was added. Moreover, the dough became more elastic with higher resistance to deformation. Adding cricket powder to baked products also darkened their color, partly due to the enhanced Maillard reaction, which is more pronounced with the increased availability of free amino acids. Moreover, Sereda et al. (2024) found that adding 15 % cricket powder significantly altered the dough's viscosity and plasticity. These changes resulted in a decrease in the volume and porosity of the final product, indicating that the dough became denser and less airy.Several studies support these findings, particularly concerning the technological function of the spread ratio in baking, which measures how much a biscuit spreads out relative to its thickness during baking (Bas and El,2022; Birò et al., 2020). R. Ardoin et al. (2021) reported that adding cricket powder to snack crackers also increased their hardness, especially when the powder exceeded 10 % of the recipe. Similarly, Bruttomesso et al. (2024) found that the hardness of pancakes significantly increased with cricket powder levels above 10 %, indicating that the additional protein and other components in cricket powder enhanced the structural integrity of the product, making it more resistant to deformation. However, the cohesiveness of the pancakes, which refers to how well the sample holds together during chewing, slightly decreased with increasing cricket powder, with a significant difference observed at 20 % and 30 % levels.

Vlahova-Vangelova et al. (2022) observed that when 5 % cricket powder was used, the cake's specific volume, shrinkage, and springiness were lower than those of the control cake, though still similar. The specific volume, which influences how airy or dense the cake is, suggests that incorporating cricket powder into sponge cakes affects their texture and sensory qualities. Higher amounts of cricket powder tend to make the cakes denser, harder, and drier, leading to less favorable sensory evaluations, while lower amounts (around 5 %) result in cakes similar to those made with wheat flour, with only slight differences in texture and springiness. Therefore, integrating cricket powder into food products requires a balanced approach to manage these sensory effects and ensure that the resulting products meet consumer expectations for taste, texture, and aroma. Based on Table 5, 17 studies examined consumer sensory evaluation of biscuits, cookies, and crackers with varying cricket powder substitutions ranging from 2 % to 25 %. Examining the reported studies, it can be found that <10 % substitution generally maintains acceptable sensory properties, particularly in cookies or

Table 7
List of studies focusing on the sensory evaluation of complementary foods products.

Product	Cricket powder quantity	Sensory method and number of judges	Evaluated sensory attributes	Sensory scale	Negative effect	Positive effect	Reference
Blends of orange-fleshed sweet potato and edible insects	- 30 %	Affective methods ***N*** = 170 Untrained judges	- Appearance - Aroma - Taste -Texture (mouthfeel) -After taste - Overall acceptability	- Five-point hedonic scale	↓ Overall acceptability ↓ Sensory acceptance (appearance, aroma, aftertaste, and texture)	↑ Nutritional composition ↑Micronutrien %	Agbemafle et al. (2020)
Complementary porridge	- 25 % - 50 % - 75 %	Affective methods ***N*** = 40 Partially trained judges	- Color - Taste - Aroma -Texture - Mouthfeel, and overall acceptability	- Nine-point hedonic scale 1 (extremely dislike) to 9 (extremely like)	↑ Dark color ↓ Consumer acceptance of the texture, mouthfeel, and aroma	↑ Protein %	R. Aboge et al. (2021)
Flour Porridge	8.3 %	Affective methods *N* = 60 Partially trained judges	- Color - Taste - Aroma - Appearance - Texture - Mouthfeel, And overall acceptability	- Nine-point hedonic scale 1 (extremely dislike) to 9 (extremely like)	↑ Dark color ↓ pasting viscosity	↑Nutritional content ↑Overall acceptability	Bbosa et al. (2025)

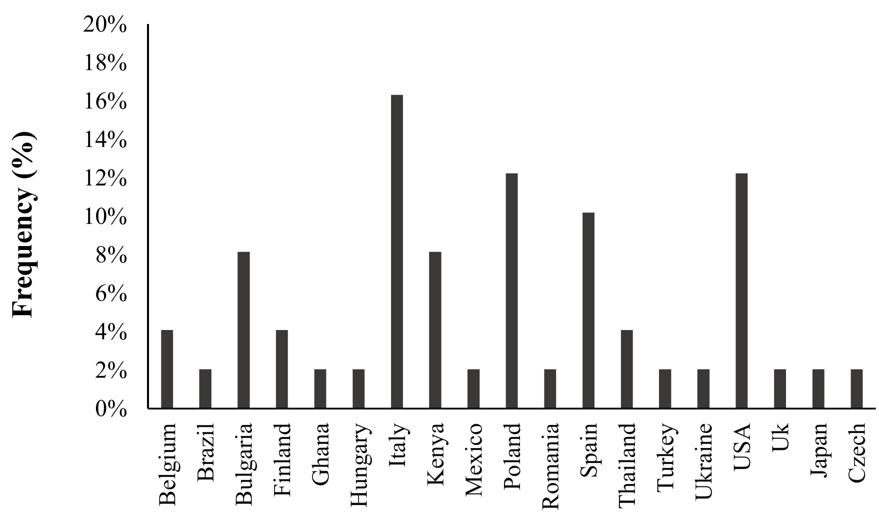

Fig. 3. Frequency (%) of research articles studying cricket powder-based food products in various countries (sum of all the articles being 100 %).

biscuits where earthy or nutty flavors can be masked by sugar or cocoa. At higher levels (>15–20 %), negative descriptors become more prominent, including dryness, bitterness, and undesirable aromas. Nonetheless, isolated studies (e.g., Bas & El, 2022) suggest that product formulation may moderate these effects, indicating opportunities for optimization through flavor masking, processing, or ingredient blending.

4.5. Pancakes and muffins

The sensory characteristics of sponge cakes containing cricket powder differ significantly from those made with traditional wheat flour. However, similar to other bakery matrices, pancakes and muffins exhibit consistent declines in texture and acceptability at high substitution levels (>10–15 %). Studies report denser crumb structures, reduced springiness, and less cohesive textures at elevated concentrations (Vlahova-Vangelova et al., 2022; Chiș et al., 2022). However, at low levels (approximately 5 %), cricket powder appears to have minimal impact on physical properties and sensory attributes, indicating a viable threshold for product developers. The recurring sensory limitations of higher substitutions reinforce the importance of balancing nutritional goals with palatability, particularly in sweet baked goods where consumer expectations for softness and mild flavor are high.

4.6. Complementary foods (Porridge)

Complementary food refers to nutrient-rich foods designed to supplement the regular diet and improve nutritional status, often formulated to enhance protein, micronutrient, and sensory quality (Adegboye, 2022; Maiyo et al., 2022). Table 7 highlights three studies focused on complementary foods, particularly porridge, aimed at developing new nutrient-dense and sustainable products. Among these, Agbemafle et al. (2020) conducted a study aiming to create nutritious and acceptable complementary foods for young children by blending orange-fleshed sweet potatoes with edible insects. Sensory evaluation, which predicts a food product's acceptability, was a focal point of this research, with maternal acceptability considered a crucial first step in providing an appropriate socio-cultural framework for the introduction of OFSP-based edible insect complementary foods into infants' diets. The study found that at a 30 % substitution of cricket powder, most mothers had lower overall acceptability of sensory characteristics compared to non-cricket complementary foods. Nevertheless, combining OFSP and house crickets shows substantial potential for improving nutrition and food security in developing regions, leveraging the high nutrient density of both ingredients to provide a sustainable and economically viable solution to malnutrition. Despite these promising results, Agbemafle et al. (2020) remains the only study on complementary porridge aimed at enhancing child nutrition in food-insecure regions, leaving gaps regarding to EFSA guidelines, optimal cricket substitution levels, and long-term health effects (Turck et al., 2024, 2021), and enhance it acceptability among young children, focusing on sensory preference, growth outcomes, and micronutrient status. Similarly, D.O. Aboge et al. (2021) assessed the sensory acceptance of a complementary porridge product incorporating cricket powder at substitution levels ranging from 20 % to 75 %, reportingthat higher levels of cricket powder led to a reduction in mothers' acceptance of the porridge's texture, mouthfeel, and aroma,whilenegatively affected the physical characteristics, consistent with findings from previous research. In contrast, Bbosa et al. (2025) demonstrated that enriching cereal porridges with 8 % *Acheta domesticus* (house crickets) caused minimal changes in physico-chemical and sensory attributes, including color, aroma, pasting, and rheological properties, supporting cricket fortification as a viable strategy to enhance nutrient content without compromising consumer acceptance. Despite some potential, significant gaps remain. Further work is needed to understand cultural acceptance, sensory drivers among young children, and the stability of cricket-fortified products under real-world storage and preparation conditions.

5. Possible strategies to overcome the negative physical and sensory effects of incorporating *Acheta domesticus* powder in foods

Acheta domesticus powder offers a valuable approach to enhancing the nutritional profile of foods, though it often challenges sensory quality, including flavor, texture, and appearance. Evidence from recent studies suggests that combining processing methods, such as defatting, roasting, enzymatic hydrolysis, and fermentation, with careful formulation—optimizing powder levels, hydration, and pH—can effectively improve taste and protein functionality. Moreover, complementary ingredients like spices, cocoa, hydrocolloids, or colorants help mask off-flavors and stabilize structure. Taken together, these strategies can mitigate negative sensory effects while preserving nutritional benefits, supporting the broader acceptance of cricket-enriched foods (Alhujaili et al., 2023; Bisconsin-Junior et al., 2025; Grossmann et al., 2021; Lisboa et al., 2025; Park et al., 2025; van Huis & Rumpold, 2023). These strategies could be effective, especially considering that the European Commission has set maximum inclusion levels of cricket powder for several food categories, such as pasta, biscuits, meat, and others (Regulation (EU) 2017/2470).

6. Conclusion and future research perspective

Acheta domesticus powder has attracted attention as a promising sustainable protein source, but its application in the food sector remains constrained by limited product diversity and consumer acceptance. While improvements in sensory and rheological properties are valuable, advancing applied food science requires moving beyond these aspects to diversify product categories and processing strategies. Expanding the use of cricket powder into dairy alternatives, confectionery, beverages, and fermented foods would broaden its market potential and address nutritional demands in new consumer segments. At the same time, emerging processing strategies such as extrusion, encapsulation, enzymatic hydrolysis, protein fractionation, and high-pressure processing offer opportunities to enhance solubility, digestibility, and stability, while investigations into Maillard reactions could clarify how heat treatments influence protein functionality and bioavailability. Alongside technological innovations, behavioral studies using segmentation approaches, neuroscience methods, and implicit testing are critical to uncover unconscious drivers of acceptance, moving beyond self-reported attitudes toward entomophagy. Equally essential is the design of complementary foods tailored for different life stages and nutritional needs. This requires systematic evaluation of substitution rates, product interactions, and storage or preparation instructions, ensuring compliance with EFSA guidelines for safety and efficacy. Together, these directions emphasize the necessity of integrating technological, nutritional, and behavioral research. Such a multidisciplinary approach will be key to accelerating the safe incorporation and commercialization of house cricket powder within diverse and consumer-friendly food systems

Funding details

This work was supported by the NextGenerationEU (EU) under Grant Prot. P20224F3BE.

Ethical statement

Naples, May 15th 2025 The ethical statement is not required, since the manuscript is a review article. No new research data have been acquired and/or reported. Dr. Sharon Puleo

CRediT authorship contribution statement

Mohammad Ammar: Writing – review & editing, Writing – original draft, Software, Investigation, Data curation. **Sharon Puleo:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Nicoletta Antonella Miele:** Writing – review & editing, Visualization. **Natália Câmara:** Writing – review & editing, Writing – original draft, Investigation. **Rossella Di Monaco:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.afres.2025.101585.

Data availability

Data will be made available on request.

References

Aboge, D. O., Orinda, M. A., & Konyole, S. O. (2021). Acceptability of complementary porridge enriched with crickets (Acheta domesticus) among women of reproductive age in Alego-Usonga Sub-County, Kenya. *African Journal of Food, Agriculture, Nutrition and Development, 21*(5), 18066–18082.

Acosta-Estrada, B. A., Reyes, A., Rosell, C. M., Rodrigo, D., & Ibarra-Herrera, C. C. (2021). Benefits and challenges in the incorporation of insects in food products. *Frontiers in nutrition, 8*, Article 687712.

Adámek, M., Adámková, A., Mlček, J., Borkovcová, M., & Bednářová, M. (2018). Acceptability and sensory evaluation of energy bars and protein bars enriched with edible insect. *Potravinarstvo Slovak Journal of Food Sciences*.

Adegboye, A. R. A. (2022). Potential use of edible insects in complementary foods for children: A literature review. *International journal of environmental research and public health, 19*(8), 4756.

Agbemafle, I., Hadzi, D., Amagloh, F. K., Zotor, F. B., & Reddy, M. B. (2020). Nutritional, microbial, and sensory evaluation of complementary foods made from blends of orange-fleshed sweet potato and edible insects. *Foods (Basel, Switzerland), 9*(9), 1225.

Aleman, R. S., Marcia, J., Pournaki, S. K., Borrás-Linares, I., Lozano-Sanchez, J., & Fernandez, I. M. (2022). Formulation of protein-rich chocolate chip cookies using cricket (Acheta domesticus) powder. *Foods (Basel, Switzerland), 11*(20), 3275.

Alemu, M. H., & Olsen, S. B. (2020). An analysis of the impacts of tasting experience and peer effects on consumers' willingness to pay for novel foods. *Agribusiness, 36*(4), 653–674.

Alhujaili, A., Nocella, G., & Macready, A. (2023). Insects as food: Consumers' acceptance and marketing. *Foods,, 12*(4), 886.

Alvarez-Barajas, A., Perez-Carrillo, E., & De la Rosa-Millan, J. (2023). Physicochemical, thermal and in vitro digestion characteristics of cricket-(Acheta domesticus) substituted corn tortillas. *International Journal of Food Science and Technology, 58*(4), 1821–1831.

Amoah, I., Cobbinah, J. C., Yeboah, J. A., Essiam, F. A., Lim, J. J., Tandoh, M. A., & Rush, E. (2023). Edible insect powder for enrichment of bakery products–A review of nutritional, physical characteristics and acceptability of bakery products to consumers. *Future Foods, 8*, Article 100251.

Ardoin, R., Romero, R., Marx, B., & Prinyawiwatkul, W. (2020). Exploring new and modified rejection-type thresholds using cricket snack crackers. *Foods (Basel, Switzerland), 9*(10), 1352.

Ardoin, R., Marx, B. D., Boeneke, C., & Prinyawiwatkul, W. (2021). Effects of cricket powder on selected physical properties and US consumer perceptions of whole-wheat snack crackers. *International Journal of Food Science and Technology, 56*(8), 4070–4080.

Arp, C. G., & Pasini, G. (2024). Exploring edible insects: From sustainable nutrition to pasta and noodle applications—A critical review. *Foods (Basel, Switzerland), 13*(22), 3587.

Ayllón-Parra, N., Castellari, M., Gou, P., & Ribas-Agustí, A. (2025). Cricket powder (Acheta domesticus) nutritional and techno-functional properties and effects of solid-state fermentation with Pleurotus ostreatus and Rhizopus oligosporus. *Innovative Food Science & Emerging Technologies*, Article 104066.

Bas, A., & El, S. N. (2022). Nutritional evaluation of biscuits enriched with cricket flour (Acheta domesticus). *International Journal of Gastronomy and Food Science, 29*, Article 100583.

Batat, W., & Peter, P. (2020). The healthy and sustainable bugs appetite: Factors affecting entomophagy acceptance and adoption in Western food cultures. *Journal of Consumer Marketing, 37*(3), 291–303.

Bawa, M., Songsermpong, S., Kaewtapee, C., & Chanput, W. (2020). Nutritional, sensory, and texture quality of bread and cookie enriched with house cricket (Acheta domesticus) powder. *Journal of Food Processing and Preservation, 44*(8), Article e14601.

Bbosa, T., Nakimbugwe, D., Matthys, C., Devaere, J., De Winne, A., Gunes, D. Z., & Van Der Borght, M. (2025). Physico-chemical and sensory characteristics of extruded cereal composite flour porridge enriched with house crickets (Acheta domesticus). *Foods (Basel, Switzerland), 14*(16), 2893.

Belleggia, L., Foligni, R., Ferrocino, I., Biolcati, F., Mozzon, M., Aquilanti, L., …, & Harasym, J. (2023). Morphotextural, microbiological, and volatile characterization of flatbread containing cricket (Acheta domesticus) powder and buckwheat (Fagopyrum esculentum) flour. *European Food Research and Technology, 249*(11), 2777–2795.

Biró, B., Sipos, M. A., Kovács, A., Badak-Kerti, K., Pásztor-Huszár, K., & Gere, A. (2020). Cricket-enriched oat biscuit: Technological analysis and sensory evaluation. *Foods (Basel, Switzerland), 9*(11), 1561.

Bisconsin-Junior, A. R., Rossi, G., Sagu, S. T., Rawel, H. M., Mariutti, L. R. B., & Schlüter, O. K. (2025). Non-thermal technologies modify protein structure and enhance functional properties of cricket protein concentrate. *Innovative Food Science & Emerging Technologies, 100*, Article 103945.

Brena-Melendez, A., Garcia-Amezquita, L. E., Liceaga, A., Pascacio-Villafán, C., & Tejada-Ortigoza, V. (2024). Novel food ingredients: Evaluation of commercial processing conditions on nutritional and technological properties of edible cricket (Acheta domesticus) and its derived parts. *Innovative Food Science & Emerging Technologies, 92*, Article 103589.

Bresciani, A., Cardone, G., Jucker, C., Savoldelli, S., & Marti, A. (2022). Technological performance of cricket powder (Acheta domesticus L.) in wheat-based formulations. *Insects, 13*(6), 546.

Bruttomesso, M., Bianchi, F., Pasqualoni, I., Rizzi, C., & Simonato, B. (2024). Evaluation of the technological and compositional features of pancakes fortified with Acheta domesticus. *LWT, 199*, Article 116073.

Cabral, E.M. (2024). Functional applications of edible insects and derived ingredients in food products. In *Insects as food and food ingredients* (pp. 133–156).

Cappelli, A., Oliva, N., Bonaccorsi, G., Lorini, C., & Cini, E. (2020). Assessment of the rheological properties and bread characteristics obtained by innovative protein sources (Cicer arietinum, Acheta domesticus, Tenebrio molitor): Novel food or potential improvers for wheat flour? *Lwt, 118*, Article 108867.

Castro Delgado, M., Chambers, E., IV, Carbonell-Barrachina, A., Noguera Artiaga, L., Vidal Quintanar, R., & Burgos Hernandez, A. (2020). Consumer acceptability in the USA, Mexico, and Spain of chocolate chip cookies made with partial insect powder replacement. *Journal of Food Science, 85*(6), 1621–1628.

Cavalheiro, C. P., Ruiz-Capillas, C., Herrero, A. M., Pintado, T., Cruz, T. D. M. P., & da Silva, M. C. A. (2023). Cricket (Acheta domesticus) flour as meat replacer in frankfurters: Nutritional, technological, structural, and sensory characteristics. *Innovative Food Science & Emerging Technologies, 83*, Article 103245.

Chiș, M. S., Păucean, A., Dreptate, F., & Man, S. (2022). Cricket (Acheta domesticus) valorization in muffins manufacturing. *Journal of Agroalimentary Processes & Technologies, 28*(2).

Choi, J. H. (2021). TAS1R2 sweet taste receptor genetic variation and dietary intake in Korean females. *Appetite, 164*, Article 105281.

Cruz-López, S. O., & Escalona-Buendía, H. B. (2024). Physicochemical and techno-functional characterization of soluble proteins extracted by ultrasound from the cricket *Acheta domesticus*. *Heliyon, 10*(5), Article e29704.

Cruz-López, S. O., Álvarez-Cisneros, Y. M., Domínguez-Soberanes, J., Escalona-Buendía, H. B., & Sánchez, C. N. (2022). Physicochemical and sensory characteristics of sausages made with grasshopper (Sphenarium purpurascens) flour. *Foods (Basel, Switzerland), 11*(5), 704.

De Marchi, L., Mainente, F., Leonardi, M., Scheurer, S., Wangorsch, A., Mahler, V., …, & Zoccatelli, G. (2021). Allergenicity assessment of the edible cricket acheta domesticus in terms of thermal and gastrointestinal processing and IgE cross-reactivity with shrimp. *Food Chemistry, 359*, Article 129878.

Deshaware, S., & Singhal, R. (2017). Genetic variation in bitter taste receptor gene TAS2R38, PROP taster status and their association with body mass index and food preferences in Indian population. *Gene, 627*, 363–368.

Dion-Poulin, A., Laroche, M., Doyen, A., & Turgeon, S. L. (2020). Functionality of cricket and mealworm hydrolysates generated after pretreatment of meals with high hydrostatic pressures. *Molecules (Basel, Switzerland), 25*(22), 5366.

Duda, A., Adamczak, J., Chełmińska, P., Juszkiewicz, J., & Kowalczewski, P. (2019). Quality and nutritional/textural properties of durum wheat pasta enriched with cricket powder. *Foods (Basel, Switzerland), 8*(2), 46.

Duku, L.T.T., Orinda, M.A., Muriithi, A.N., & Aboge, D.O. (2023). Nutritional composition and sensory evaluation of biscuits fortified with sorghum (Sorghum bicolor) and cricket powder (Acheta domesticus) for improved food security.

FAO. (2021). Global agriculture towards 2050. *How to feed the world 2050*. High-level expert forum.

Fröhling, A., Bußler, S., Durek, J., & Schlüter, O. K. (2020). Thermal impact on the culturable microbial diversity along the processing chain of flour from crickets (Acheta domesticus). *Frontiers in microbiology, 11*, 884.

Gantner, M., Sadowska, A., Piotrowska, A., Kulik, K., Sionek, B., & Kostyra, E. (2024). Wheat bread enriched with house cricket powder (Acheta domesticus L.) as an alternative protein source. *Molecules (Basel, Switzerland), 29*(3), 711.

González, C. M., Garzón, R., & Rosell, C. M. (2019). Insects as ingredients for bakery goods. A comparison study of H. illucens, A. domestica and T. molitor flours. *Innovative Food Science & Emerging Technologies, 51*, 205–210.

Gottardi, D., Siroli, L., Rossi, S., Di Nunzio, M., & Barbiroli, A. (2024). Effect of combined high-pressure homogenization and biotechnological processes on chitin, protein, and antioxidant activity of cricket powder (*Acheta domesticus*). *Foods (Basel, Switzerland), 13*(3), 449.

Grossmann, K. K., Merz, M., Appel, D., De Araujo, M. M., & Fischer, L. (2021). New insights into the flavoring potential of cricket (Acheta domesticus) and mealworm (Tenebrio molitor) protein hydrolysates and their Maillard products. *Food Chemistry, 364*, Article 130336.

Han, X., Li, B., Puolanne, E., & Heinonen, M. (2023). Hybrid sausages using pork and cricket flour: Texture and oxidative storage stability. *Foods (Basel, Switzerland), 12*(6), 1262.

Ho, I., Peterson, A., Madden, J., Huang, E., Amin, S., & Lammert, A. (2022). Will it cricket? Product development and evaluation of cricket (Acheta domesticus) powder replacement in sausage, pasta, and brownies. *Foods (Basel, Switzerland), 11*(19), 3128.

Homann, A. M., Ayieko, M. A., Konyole, S. O., & Roos, N. (2017). Acceptability of biscuits containing 10% cricket (Acheta domesticus) compared to milk biscuits among 5-10-year-old Kenyan schoolchildren. *Journal of Insects as Food and Feed, 3*(2), 95–104.

Hussain, A., Khan, N., & Ahmad, I. (2017). Impact of seasonal and geographical variation on the male call song structure of the common house cricket Acheta domesticus (L.). *Int. J. Biol. Biotech, 14*, 359–370.

Igual, M., García-Segovia, P., & Martínez-Monzó, J. (2020). Effect of Acheta domesticus (house cricket) addition on protein content, colour, texture, and extrusion parameters of extruded products. *Journal of Food Engineering, 282*, Article 110032.

Indelicato, S., Lino, C., Bongiorno, D., Orecchio, S., D'Agostino, F., Indelicato, S., …, & Avellone, G. (2025). Cricket flour for a sustainable pasta: Increasing the nutritional profile with a safe supplement. *Foods (Basel, Switzerland), 14*(14), 2404.

Ivanišová, E., Rajnoha, M., Harangozo, Ľ., Kunecová, D., Čech, M., Gabríny, L., …, & Pietrzak-Fiećko, R. (2023). Physicochemical, nutritional, antioxidant, and sensory properties of crackers supplemented with edible insects. *Applied Sciences, 13*(21), Article 11911.

Jürkenbeck, K., von Steimker, F., & Spiller, A. (2024). Consumer's perception of food pairing products with usual, novel and unusual flavour combinations: A segmentation approach. *Appetite, 196*, Article 107270.

Keto, L., Stefanski, T., Isokangas, A., Rautio, P., Rokka, S., & Pihlanto, A. (2018). A pilot study: Consumer acceptability of Polish style cooked sausages containing house cricket flour. *Suomen Maataloustieteellisen Seuran Tiedote*, (35), 1–7.

Khalil, R., Baba, Y., Kallas, Z., Haddarah, A., & Pujolà, M. (2025). Preferences of consumers engaged in sports towards high-protein snacks with cricket flour and carob: Determinant factors and hedonic evaluation. *Journal of Insects as Food and Feed, 1*(aop), 1–15.

Khatun, H., Van Der Borght, M., Akhtaruzzaman, M., & Claes, J. (2021). Rheological characterization of chapatti (roti) enriched with flour or paste of house crickets (Acheta domesticus). *Foods (Basel, Switzerland), 10*(11), 2750.

Kim, T. K., Cha, J. Y., Yong, H. I., Jang, H. W., Jung, S., & Choi, Y. S. (2022). Application of edible insects as novel protein sources and strategies for improving their processing. *Food Science of Animal Resources, 42*(3), 372.

Kolev, N., Vlahova-Vangelova, D., Balev, D., Gradinaska, D., & Dragoev, S. (2022). Quality characteristics of cooked poultry meatballs with addition of cricket powder (Acheta domestica).

Kowalczewski, P.Ł., Siejak, P., Jarzębski, M., Jakubowicz, J., Jeżowski, P., Walkowiak, K., …, & Baranowska, H. M. (2023). Comparison of technological and physicochemical properties of cricket powders of different origin. *Journal of Insects as Food and Feed, 9*(5), 637–646.

Kowalski, S., Mikulec, A., Mickowska, B., Skotnicka, M., & Mazurek, A. (2022). Wheat bread supplementation with various edible insect flours. Influence of chemical composition on nutritional and technological aspects. *Lwt, 159*, Article 113220.

Lisboa, H. M., Andrade, R., Lima, J., Batista, L., Costa, M. E., Sarinho, A., & Pasquali, M. B. (2025). Harnessing insects as novel food ingredients: Nutritional, functional, and processing perspectives. *Insects,, 16*(8), 783.

Liu, J., Cattaneo, C., Papavasileiou, M., Methven, L., & Bredie, W. L. (2022). A review on oral tactile sensitivity: Measurement techniques, influencing factors and its relation to food perception and preference. *Food Quality and Preference, 100*, Article 104624.

Lombardi, A., Vecchio, R., Borrello, M., Caracciolo, F., & Cembalo, L. (2019). Willingness to pay for insect-based food: The role of information and carrier. *Food Quality and Preference, 72*, 177–187.

Mafu, A., Ketnawa, S., Phongthai, S., Schönlechner, R., & Rawdkuen, S. (2022). Whole wheat bread enriched with cricket powder as an alternative protein. *Foods (Basel, Switzerland), 11*(14), 2142.

Maiyo, N. C., Khamis, F. M., Okoth, M. W., Abong, G. O., Subramanian, S., Egonyu, J. P., …, & Tanga, C. M. (2022). Nutritional quality of four novel porridge products blended with edible cricket (Scapsipedus icipe) meal for food. *Foods (Basel, Switzerland), 11*(7), 1047.

Mazurek, A., Palka, A., Skotnicka, M., & Kowalski, S. (2022). Consumer attitudes and acceptability of wheat pancakes with the addition of edible insects: Mealworm (Tenebrio molitor), buffalo worm (Alphitobius diaperinus), and cricket (Acheta domesticus). *Foods (Basel, Switzerland), 12*(1), 1.

Mehra, R., Pandey, A. K., & Guiné, R. P (2024). *Sensory science applications for food production*. IGI Global.

Mishyna, M., Chen, J., & Benjamin, O. (2020). Sensory attributes of edible insects and insect-based foods–Future outlooks for enhancing consumer appeal. *Trends in Food Science & Technology, 95*, 141–148.

Mugova, A. K., Zvidzai, C., & Musundire, R. (2021). Techno-functional properties of armoured cricket (Acanthoplus discoidalis) flour. *Scholar Journal of Engineering and Technology, 8*, 102–112.

Mwanyigha, W.M., Muriithi, A.N., & Konyole, S.O. (2023). Acceptability and nutritional quality of finger millet (Eleusine coracana) cookies enriched with cricket (Acheta domesticus).

Ndiritu, A. K., Kinyuru, J. N., Kenji, G. M., & Gichuhi, P. N. (2017). Extraction technique influences the physico-chemical characteristics and functional properties of edible crickets (Acheta domesticus) protein concentrate. *Journal of Food Measurement and Characterization, 11*, 2013–2021.

Orkusz, A., Dymińska, L., & Prescha, A. (2024). Assessment of changes in the fat profile of house cricket flour during 12 months of storage in various conditions. *Foods (Basel, Switzerland), 13*(15), 2566.

Ortolá, M. D., Martínez-Catalá, M., Yuste Del Carmen, A., & Castelló, M. L. (2022). Physicochemical and sensory properties of biscuits formulated with Tenebrio molitor and Alphitobius diaperinus flours. *Journal of Texture Studies, 53*(4), 540–549.

Osimani, A., Milanović, V., Cardinali, F., Roncolini, A., Garofalo, C., Clementi, F., …, & Aquilanti, L. (2018). Bread enriched with cricket powder (Acheta domesticus): A technological, microbiological and nutritional evaluation. *Innovative food science & emerging technologies, 48*, 150–163.

Pambo, K. O., Mbeche, R. M., Okello, J. J., Mose, G. N., & Kinyuru, J. N. (2018). Intentions to consume foods from edible insects and the prospects for transforming the ubiquitous biomass into food. *Agriculture and Human Values, 35*, 885–898.

Park, S., Chambers, E., IV, & Lee, J. (2025). Cross-cultural comparison (13 Countries) of consumers' Willingness to eat specific insect powders in five food types. *Foods (Basel, Switzerland), 14*(5), 841.

Pasini, G., Cullere, M., Vegro, M., Simonato, B., & Dalle Zotte, A. (2022). Potentiality of protein fractions from the house cricket (Acheta domesticus) and yellow mealworm (Tenebrio molitor) for pasta formulation. *LWT, 164*, Article 113638.

Pasqualin Cavalheiro, C., Ruiz-Capillas, C., Herrero, A. M., Pintado, T., Avelar de Sousa, C. C., Sant'Ana Falcão Leite, J., & Costa Alves da Silva, M. (2024). Potential of cricket (Acheta domesticus) flour as a lean meat replacer in the development of beef patties. *Foods,, 13*, 286.

Payne, C. L., Scarborough, P., Rayner, M., & Nonaka, K. (2016). A systematic review of nutrient composition data available for twelve commercially available edible insects, and comparison with reference values. *Trends in Food Science & Technology, 47*, 69–77.

Pecova, M., Tauferová, A., Pospiech, M., Bartlová, M., & Tremlová, B. (2023). Evaluation of gluten-free bars made with House cricket (Acheta domesticus) powder. *Journal of microbiology, biotechnology and food sciences, 13*(1). e9873-e9873.

Pilco-Romero, G., Chisaguano-Tonato, A. M., Herrera-Fontana, M. E., Chimbo-Gándara, L. F., Sharifi-Rad, M., Giampieri, F., …, & Álvarez-Suárez, J. M. (2023). House cricket (Acheta domesticus): A review based on its nutritional composition, quality, and potential uses in the food industry. *Trends in Food Science & Technology, 142*, Article 104226.

Piqueras-Fiszman, B., & Spence, C. (2014). Colour, pleasantness, and consumption behaviour within a meal. *Appetite, 75*, 165–172.

Puleo, S., Braghieri, A., Pacelli, C., Bendini, A., Toschi, T. G., Torri, L., …, & Di Monaco, R. (2021a). b. Food neophobia, odor and taste sensitivity, and overall flavor perception in food. *Foods (Basel, Switzerland), 10*(12), 3122.

Puleo, S., Masi, P., Cavella, S., & Di Monaco, R. (2021b). a. Oral sensitivity to flowability and food neophobia drive food preferences and choice. *Foods (Basel, Switzerland), 10*(5), 1024.

Puleo, S., Fiore, A., Sieghartsleitner, A., Russo, G. L., Grigor, J., & Di Monaco, R. (2025). Cricket flour integration in biscuits: A study on formulation and consumer acceptance. *Journal of Insects as Food and Feed*, Article 100583.

Ribeiro, J. C., Pintado, M. E., & Cunha, L. M. (2024). Consumption of edible insects and insect-based foods: A systematic review of sensory properties and evoked emotional response. *Comprehensive Reviews in Food Science and Food Safety, 23*(6), 13547–13570.

Rocchetti, G., Leni, G., Rebecchi, A., Dordoni, R., Giuberti, G., & Lucini, L. (2024). The distinctive effect of different insect powders as meat extenders in beef burgers subjected to cooking and in vitro gastrointestinal digestion. *Food Chemistry, 442*, Article 138422.

Ruszkowska, M., Tańska, M., & Kowalczewski, P.Ł. (2022). Extruded corn snacks with cricket powder: Impact on physical parameters and consumer acceptance. *Sustainability, 14*(24), Article 16578.

Saldaña, E., Eduardo, K., Mayta-Hancco, J., Huamán-Castilla, N. L., & Escobedo-Pacheco, E. (2024). Application of sensory and consumer science for the development of novel food products. *Current Food Science and Technology Reports, 2*(2), 183–199.

Sereda, O., Melnyk, O., Marenkova, T., Koshel, O., & Bokovets, S. (2024). The rheological characteristics of the dough for semi-finished biscuits with the addition of crickets flour(*Acheta domesticus*). *Ukrainian Journal of Food Science, 12*(1), 25–37.

Sharif, M. K., Butt, M. S., Sharif, H. R., & Nasir, M. (2017). Sensory evaluation and consumer acceptability. *Handbook of food science and technology, 10*, 362–386.

Siddiqui, S. A., Zhao, T., Fitriani, A., Rahmadhia, S. N., Alirezalu, K., & Fernando, I. (2024). Acheta domesticus (house cricket) as human foods-an approval of the European Commission-A systematic review. *Food Frontiers, 5*(2), 435–473.

Sogari, G., Menozzi, D., Hartmann, C., & Mora, C. (2019). *Edible insects in the food sector* (pp. 27–44). Cham, Switzerland: Springer International Publishing.

Spence, C., Levitan, C. A., Shankar, M. U., & Zampini, M. (2010). Does food color influence taste and flavor perception in humans? *Chemosensory perception, 3*, 68–84.

Spence, C. (2015). On the psychological impact of food colour. *Flavour,, 4*, 1–16.

Spence, C. (2018). Background colour & its impact on food perception & behaviour. *Food Quality and Preference, 68*, 156–166.

Stone, A. K., Tanaka, T., & Nickerson, M. T. (2019). Protein quality and physicochemical properties of commercial cricket and mealworm powders. *Journal of Food Science and Technology, 56*(7), 3355–3363.

Suga, N., Tsumura, E., Naito, Y., Hamaguchi, I., Matsuda, S., Kawabata, K., & Sakamoto, K. (2023). Thermal stability of cricket powder and its effects on antioxidant activity, physical, and sensory properties of rice crackers. *LWT, 186*, Article 115267.

Tarahi, M., Hedayati, S., & Niakousari, M. (2024). Supplementation of cereal products with edible insects: Nutritional, techno-functional, and sensory properties. *Food Reviews International*.

Turck, D., Bohn, T., Castenmiller, J., De Henauw, S., Hirsch-Ernst, K. I., Maciuk, A., Mangelsdorf, I., McArdle, H. J., Naska, A., Pelaez, C., Pentieva, K., Siani, A., Thies, F., Tsabouri, S., Vinceti, M., Cubadda, F., Frenzel, T., Heinonen, M., Marchelli, R., …, & Knutsen, H. K. (2021). Safety of frozen and dried formulations from whole house crickets (Acheta domesticus) as a novel food pursuant to regulation (EU) 2015/2283. *In efsa journal (Vol. 19, issue 8)*. John Wiley and Sons Inc.

Turck, D., Bohn, T., Cámara, M., Castenmiller, J., De Henauw, S., Hirsch-Ernst, K. I., Jos, Á., Maciuk, A., Mangelsdorf, I., McNulty, B., Naska, A., Pentieva, K., Siani, A., Thies, F., Aguilera-Gómez, M., Cubadda, F., Frenzel, T., Heinonen, M., Neuhäuser-Berthold, M., …, & McArdle, H. J. (2024). Safety of frozen, dried and powder forms of house crickets (Acheta domesticus) as a novel food pursuant. *EFSA Journal, 22*(12).

Udomsil, N., Imsoonthornruksa, S., Gosalawit, C., & Ketudat-Cairns, M. (2019). Nutritional values and functional properties of house cricket (Acheta domesticus) and field cricket (Gryllus bimaculatus). *Food Science and Technology Research, 25*(4), 597–605.

Umebara, I., Akutsu, K., Kubo, M., Iijima, A., Sakurai, R., Masutomi, H., & Ishihara, K. (2024). Analysis of fatty acid composition and volatile profile of powder from edible crickets (Acheta domesticus) reared on apple by-products. *Foods (Basel, Switzerland), 13*(11), 1668.

van Huis, A., & Rumpold, B. (2023). Strategies to convince consumers to eat insects? A review. *Food Quality and Preference, 110*, Article 104927.

Van Huis, A. (2018). Chapter 11 - Insects as human food. In R. R. Nobrega Alves, & U. P. Albuquerque (Eds.), *Ethnozoology* (pp. 195–213). Academic Press.

Ververis, E., Boue, G., Poulsen, M., Pires, S. M., Niforou, A., Thomsen, S. T., …, & Naska, A. (2022). A systematic review of the nutrient composition, microbiological and toxicological profile of Acheta domesticus (house cricket). *Journal of Food Composition and Analysis, 114*, Article 104859.

Vlahova-Vangelova, D. B., Balev, D. K., Kolev, N. D., Gradinarska, D. N., & Dragoev, S. G. (2021). Cricket powder (Acheta domestica) as food additive for processing of dry-fermented poultry bars. *Scientific Study & Research. Chemistry & Chemical Engineering, Biotechnology, Food Industry, 22*(4), 453–461.

Vlahova-Vangelova, D. B., Balev, D. K., Kolev, N. D., Dinkova, R. H., & Stankov, S. S. (2022). Technological and sensory properties of sponge cakes containing cricket flour (Acheta domesticus). *Carpathian Journal of Food Science & Technology, 14*(1).

Vlahova-Vangelova, D., Balev, D., & Kolev, N. (2023). Cricket powder (Acheta domesticus) as a lean pork meat replacer in cooked sausages. *Future Food: J. Food Agric. Soc, 11*, 1–12.

Wangorsch, A., Jamin, A., Spiric, J., Vieths, S., Scheurer, S., Mahler, V., & Hofmann, S. C. (2024). Allergic reaction to a commercially available insect snack caused by house cricket (Acheta domesticus) tropomyosin. *Molecular Nutrition & Food Research, 68*(5), Article 2300420.

Zielińska, E. (2022). Evaluating the functional characteristics of certain insect flours (non-defatted/defatted flour) and their protein preparations. *Molecules (Basel, Switzerland), 27*(19), 633.

Further reading

Perez-Fajardo, M., Bean, S. R., & Dogan, H. (2023). Effect of cricket protein powders on dough functionality and bread quality. *Cereal Chemistry, 100*(3), 587–600.