

## Snacking insects? A global market investigation

Giulia Andreani<sup>a</sup>, Giovanni Sogari<sup>a,\*</sup>, Marija Banović<sup>b</sup>

<sup>a</sup> Department of Food and Drug, University of Parma, Parma, Italy

<sup>b</sup> MAPP Centre, Department of Management, Aarhus University, Aarhus, Denmark

### ARTICLE INFO

#### Keywords:

*Acheta domesticus*  
Entomophagy  
Protein  
Snack bar  
Sustainability  
*Tenebrio molitor*

### ABSTRACT

The world population is expected to grow rapidly and exceed 10.4 billion by 2100. In this scenario, greater environmental pressure and natural resource scarcity are inevitable. A possible solution suggested by international authorities is the use of novel protein sources for conventional production, such as the use of edible insects as food, in Western countries. The present work investigates recent market trends in the edible insect sector, in terms of a growing focus on sustainability, product offerings, diversification of insect-based products, and increasing consumer awareness. The Mintel Global New Product Database was used to identify newly launched products in the global market that incorporate insects as ingredients. The market analysis focused on the food category with the highest number of newly launched products, the insect snack bar category. The results of a global market investigation on insect snack bars are further presented including the market analysis of several aspects, such as price, country distribution, nutritional values, and communication strategies. Finally, market considerations are provided that could interest stakeholders in the insect supply chain, including retailers, manufacturers, and policymakers.

### 1. Introduction

In the last decade, public attention has been directed toward finding new alternative protein sources to address nutrition and environmental challenges (Banovic et al., 2018; Banovic et al., 2022). A possible solution suggested by international authorities is the use of novel food sources, such as the use of plant-based alternatives to conventional animal products (Andreani et al., 2023) and/or edible insects as food and feed (van Huis et al., 2013). With the increasing awareness of environmental and nutritional issues, insects are being recognized as a sustainable, eco-friendly, and valuable nutritional protein source (Committee on Agriculture and Rural Development, 2023). This is driving consumer interest, especially among environmentally conscious consumers (Menozzi, Sogari, Veneziani, Simoni, and Mora., 2017).

Edible insects could be marketed as whole-body or as ingredients (e.g., powder), which are then incorporated into familiar foods (e.g., pasta, snack/cereal/energy bars, savory biscuits/crackers) (Boukid, Sogari and Rosell, 2022; Montanari, Pinto de Moura and Miguel Cunha, 2021). Generally, insect powders could be added to replace other ingredients, thereby changing the nutritional content of the food (Sogari et al., 2023). In fact, insects are excellent nutritional sources, containing between 43.9 g and 77.1 g/100 g of complete proteins (Gomes et al.,

2023), which leads to increased protein content in the final products (Sogari et al., 2023). In addition, when replacing animal ingredients, insects could contribute to overcoming environmental challenges, such as reducing greenhouse gas emissions and optimizing the use of natural resources (van Huis et al., 2013).

Despite the potential benefits of insects as food, psychological traits – such as food neophobia (i.e., reluctance to eat unfamiliar foods) and disgust (i.e., emotional defense reaction) – represent critical barriers in determining Westerners' acceptance of entomophagy, i.e., eating edible insects (Dagevos, 2021). To overcome this rejection ('yuck factor'), which is often linked to the presence of a visible insect as food, past literature (Dagevos, 2021; Videbæk and Grunert, 2020) has suggested that consumers are more willing to accept familiar-tasting foods in which insects' presence is "hidden" (i.e., by including them in an invisible form, such as powdered) than as single, whole food (Sogari et al., 2023). As a result, most consumer studies carried out in Europe and North America have focused on how consumers respond to familiar processed foods with insects as ingredients rather than whole insects as food (Boukid et al., 2022; Alhujaili, Nocella and Macready, 2023).

Although a substantial amount of literature has recently emerged on the topic (Boukid et al., 2022; Dagevos, 2021; Sogari et al., 2023), the insect food industry still needs to improve marketing strategies (e.g.,

\* Correspondence to: Department of Food and Drug, University of Parma, Parco Area delle Scienze 27/A, Parma 43124, Italy.

E-mail addresses: [giulia.andreani@unipr.it](mailto:giulia.andreani@unipr.it) (G. Andreani), [giovanni.sogari@unipr.it](mailto:giovanni.sogari@unipr.it) (G. Sogari), [maba@mgmt.au.dk](mailto:maba@mgmt.au.dk) (M. Banović).

product, price, place, promotion) to make insect-based products more appealing to consumers. The promotion of insect food products could strongly depend on several factors, including the product's taste and appropriateness, nutritional value, food safety, and health and sustainability aspects (Dagevos, 2021). However, other strategies to support insect consumption could be based on the current drives of entomophagy (e.g., hedonic pleasure) in countries with such a tradition (e.g., Mexico) rather than focusing on nutritional and sustainability aspects (Gómez-Corona and Valentin, 2023). In addition, it is also interesting to note that even a single nation's regional difference in geography may emphasize cultural differences in how edible insects are socially represented (Bisconsin-Júnior et al., 2020). Therefore, instead of using a single marketing approach, strategies could focus on the values and beliefs of the regional culture subgroups.

According to the International Platform of Insects for Food & Feed (IPIFF) report "Edible insects on the European market" (IPIFF, 2020), in terms of food application, the market share of bars, biscuits, and other snacks with insects is going to grow in the upcoming years. Among the insect species most used for such product categories, previous literature has identified the yellow mealworm (*Tenebrio molitor*), the house cricket (*Acheta domesticus*), and the migratory locust (*Locusta migratoria*) (Montanari, Pinto de Moura, and L. Miguel Cunha, 2021).

Pippinato, Gasco, G. Di Vita, and T. Mancuso, 2020 have classified insect companies into two main groups: the first one is comprised of producers involved in the sports sector, who sell protein meals and energy/protein bars, with different percentages of insect powder, whereas the second group includes producers of snacks using the whole insect, with different types of preparation (e.g., roasted, dried, or freeze-dried). Interestingly, despite the edible insect sector still being in its infancy, specifically in the European market (Montanari et al., 2021), there are a few insect-based food categories that have gained more attention than others, i.e., snacks (Boukid, Sogari, and C.M. Rosell, 2022). As a result, scientific research on product development and consumer acceptance of snacks made with edible insects, including bars, has increased during the last few years (Siddiqui et al., 2023; Alhujaili et al., 2023).

Recent studies investigated how to formulate an extruded snack by adding insect protein through the use of different insect species, with various % of insect powder ranging from 5 to 20 % (Gomes et al., 2023). A recent review by Ribeiro, Pintado, and Cunha. (2024) found that insect incorporation has a greater impact on appearance, odor, and flavor/taste than on texture (Ribeiro, Pintado and Cunha, 2024). In terms of consumer perception of these products, (Cicatiello, Vitali and Lacerata, 2020) conducted one of the first sensory studies employing insect foods and found that consumers preferred a chocolate bar with 5.5 % cricket flour in comparison to eating the whole cricket. Another consumer study, conducted by (Verneau et al., 2016), concluded that communication about the individual and social benefits of eating insects has an impact on consumers' attitudes and intentions toward eating a chocolate bar with peanuts enriched with cricket proteins. In addition, (Lombardi, Vecchio, Borrello, Caracciolo, and Cembalo, 2019) showed that providing information on benefits for the individuals (i.e., "insects are a source of protein") and the community (i.e., "low environmental impact compared to livestock") increased consumers' willingness to pay for an insect chocolate bar. Finally, a study by (Placentino, Sogari, Viscecchia, Devitiis, and L. Monacis, 2021) investigated the factors influencing the acceptance of an energy bar enriched with cricket protein as a dietary supplement among professional athletes. Results showed that the main motivation to consume the product was the high protein content, which was connected to improved performance and recovery from exercise and preventing deficiencies. However, studies focusing on how the packaging design influences consumer reactions to insect-based food products have only recently begun to emerge (Hémar-Nicolas, Thomas, Gallen, and Pantin-Sohier, 2024). In addition, it is currently not clear what information is best to disclose about the presence of insects.

Considering these stimulating results on consumers' perception of insect snack bars, it would be of interest to investigate the current market trends and identify the direction of this sector. Therefore, in the present short communication, we explore the latest market trends in the insect snack bar sector, including price, country, nutrition contents, and information provided by food companies. Retailers, industries, and policymakers could benefit from the data retrieved from this work to define communication schemes (in terms of claim and food labeling) and to better shape market strategies.

## 2. Methodology

To investigate recent market trends in edible insects, we carried out a market analysis using Mintel's Global New Product Database (GNPD) – <https://www.mintel.com/products/gnpd> – an online database for new, global product launches. We chose Mintel over other business-related databases due to its highly detailed product information for each item, including claims, price, nutritional facts, as well as front and back pictures (Solis, 2016). The same database has been already employed in previous research to perform market analysis of food products, such as plant-based meat alternatives (Andreani et al., 2023; Boukid et al., 2022).

We decided to focus our investigation on the edible insect species that are currently authorized in the European Union (EU), and which can, therefore, be commercialized in the EU market (European Commission, 2023). The decision to consider EU-authorized species only was taken due to the local growing interest, both in terms of scientific publications and insect food product launches (Boukid et al., 2022). Furthermore, the species currently authorized in the EU are also the most studied in terms of farming and food processing and, thus, are the most relevant for food companies (Sogari et al., 2023). Specifically, in the EU, the regulatory framework concerning the production and marketing of novel foods has been reformed and insect-based products currently fall under the scope of application of Regulation (EU) 2015/2283 (EFSA Scientific Committee 2015). The European Commission has authorized the placing on the market of four insect species: *Tenebrio molitor* (yellow mealworm), *Locusta migratoria* (migratory locust), *Acheta domesticus* (house crickets), and *Alphitobius diaperinus* (lesser mealworm) (Sogari et al., 2023).

Starting from these four insect species, the search was performed in May 2023 and covered worldwide new launches for all food categories (e.g., beverages, snacks, breakfast cereals, etc.) that include insects as ingredients in the period from January 2014 to May 2023; the search strategy is described in Appendix A (Table A1). The data on new product launches was extracted in the form of spreadsheets, where each column reported different pieces of information, such as food category, price, nutritional values, and claims. Our analysis encompassed overall new product launches in the insect-based food sector, ultimately focusing on snack products as the most promising category due to their high potential for consumer acceptance and market growth (Boukid et al., 2022), and due to the higher number of product launches during the last years. Therefore, data analysis was conducted for the snack bar food category by examining different aspects, such as price, nutritional values, and claims, to provide a comprehensive understanding of the insect snack bar market. Besides this comprehensive analysis, further investigations were conducted to explore selected company websites within the sector, with a focus on discerning manufacturers' prioritized information and comparing content across various websites to identify industry trends and unique positioning strategies. The collected information was analyzed through thematic analysis, a qualitative, structured approach used to interpret data and provide insights into the themes of a dataset (Braun and Clarke, 2006; Braun et al., 2019; Chen, Liu, Yan, Hu and Shi, 2021). This analysis followed a three-step approach: i) companies' websites were searched by one researcher, who browsed the webpages and reported the main communication messages associated with the product under investigation; ii) two

research members then coded each sentence/message independently; iii) concepts were discussed by research members and a single code/-concept was agreed and assigned to each message.

### 3. Results

The data analysis revealed a total of 148 new product launches in the insect-based food sector during the period from January 2014 to May 2023 for the four EU-authorized insect species (Fig. 1). Among these, the majority, accounting for 51 % (n = 76), were snack products, which surpassed other food categories such as bakery foods (11 %, n = 17) and side dishes (7 %, n = 9). Consequently, for a more targeted and focused market analysis, we directed our investigation toward the snacks category, which also recognizes its significant market potential and relevance within the broader insect-based food sector.

The Mintel dataset further divided the insect snack category into several sub-categories – e.g., snack bars, chips, dried insects – all of them including at least one of the EU-authorized insects as an ingredient. Further analysis highlighted that within the new product launches in the snacks category (n = 76), 55 % (n = 42) of the products were snack bars (e.g., energy bars) containing insects as an ingredient. The remaining 45 % (n = 34) was mostly comprised of dried insects, followed by chips-like products. Given that the majority of newly launched insect snacks were snack bars and given the expected growth in the snack bar sector (Constantin and Istrati, 2018; Agriculture and Agri-Food Canada, 2017), the results presented in this manuscript revolve around the sub-category of snack bars containing insects as an ingredient.

#### 3.1. Insect snack bars

The 42 insect snack bars retrieved from the GNPD cover a period from 2014 to 2023, with the first product being a cricket snack bar (Chapul Aztec Cricket Bar®) launched in the US. The data analysis revealed that Canada is at the forefront in the insect snack bar category, with 17 new product launches (e.g., a raspberry apricot cricket energy bar in 2018 and a cookie dough protein bar in 2020). Other active countries in this market are the United States (n = 4), New Zealand (n = 1), Thailand (n = 1), and several European countries, specifically, Germany (n = 6), Spain (n = 4), the United Kingdom (n = 3), the Czech Republic (n = 2), Belgium (n = 2), Sweden (n = 1), and Denmark (n = 1). A geographical representation of this market distribution is represented in Fig. 2.

Out of the 42 newly launched products, the insect snack bar market is predominantly dominated by products containing crickets. In fact, most snack bars (n = 39) included house cricket (*Acheta domesticus*) as an ingredient, followed by two products that contained yellow mealworm (*Tenebrio molitor*), and one with lesser mealworm (*Alphitobius diaperinus*). No insect snack bar incorporated migratory locust (*Locusta migratoria*) as an ingredient.

*migratoria*) as an ingredient.

To analyze the pricing, data were converted into € per kg across the eleven different countries included in the analysis. This analysis revealed, on a general level, an average price of 54.1€/kg for an insect snack bar. The minimum and maximum prices per kg were 40€/kg for a cricket bar launched in Canada in 2018 and 99.7€/kg for a cricket protein bar launched in Spain in 2019. For the packaging, the packaging size ranged from 30 g to 60 g. Considering the mean packaging size of 47.3 g, the average price per single bar was 2.56€.

Along with the above information, the nutritional values of the products were also collected. All the nutritional values were converted and standardized to measurements per 100 g, which enabled the analysis of different nutritional aspects of the insect snack bars and their comparison with regular snack bars (Table 1). Apart from some differences, the nutritional values of the two snack bar types are comparable, with insect snack bars being higher in fats and proteins, and lower in carbohydrates, when compared to regular snack bars. The insect snack bars included in the analysis contained, on average, 19 % fats, 44 % carbohydrates, and 18 % proteins.

It is worth mentioning that the food industry is continuously developing new formulations for snack bars in general, and many different brands and bar types exist, thus nutritional values can differ from product to product (Constantin and Istrati, 2018). Overall, considering the values presented in Table 1, insect snack bars can be considered a source of protein since more than 12 % of their energy value is provided by protein (Commission Regulation (EU), 2012).

The use of claims on the product packaging was further analyzed based on the Mintel dataset. Claims are generally used by food companies to communicate information and promote specific aspects of their products, such as sustainability, nutrient content, processing, or hedonistic information (Rybak, Burton, Johnson, Berry, 2021). Investigating the most common claims on insect snack bars' packaging can provide insights into the types of information that manufacturers aim to stress to consumers. The analysis of the frequency of reported claims showed that the claims appearing in more than half of the products (> 21 insect snack bars) were either nutrient-/health-related (e.g., "Allergen Free", "Gluten Free", "High Protein") or sustainable-related ("Environmentally friendly"). The word cloud in Fig. 3 emphasizes the most used claims on the newly launched insect snack bar packaging.

In addition to analyzing the packaging claims, the research was expanded to include a thorough exploration of company websites in this sector to understand what information manufacturers prioritize on their websites and in their online presence. The comparison of content across different company websites allowed for the identification of industry trends and unique positioning strategies. Out of 42 products, we identified 19 different companies (e.g., Naak, SENS Food, Crickstart Food, Entoma). In line with the claims used on products, the thematic analysis showed that the main themes and messages companies' websites focus on in their communication, promotion, and engagement strategies are related to the health and/or environmental benefits of using insects. For the health aspect, the most often mentioned aspect is the presence of complete proteins, which "help maximize muscle recovery and build a healthier and happier gut". However, this is not the only benefit stressed by food companies. For instance, the use of cricket powder specifically is promoted by underlying the presence of vitamin B12 and a high fiber content. Regarding the sustainability theme, companies often highlight the use of "sustainable proteins" and compare the environmental impact of insects to the one of conventional protein sources (i.e., meat or whey) in terms of greenhouse gas emissions, and land and water usage. Visual and multimedia elements, such as images and graphics, support the above-mentioned promotional and engagement strategies. Finally, insect snack bars are frequently promoted by companies as they "ideally suit the needs of athletes who demand functional and high-quality sports nutrition and who also follow a sustainable lifestyle".

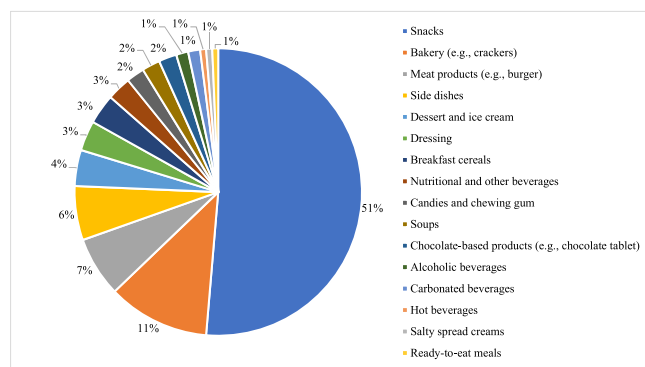
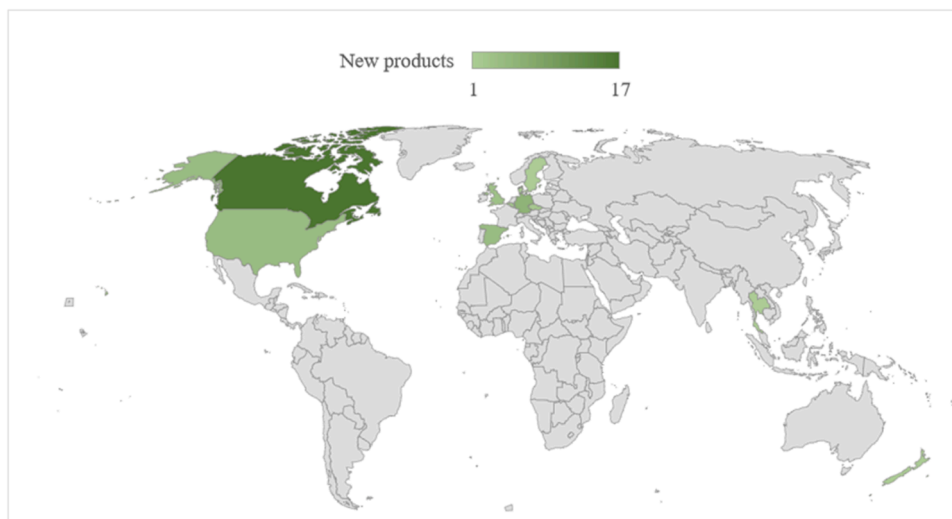


Fig. 1. New product launches of insect-based foods (in %) including EU-authorized insects as ingredients divided by food category (n = 148). Source: Own elaboration. Data from Mintel Database, 2023.



**Fig. 2.** Global distribution of new snack bars containing insects (n = 42) in the world market. Note: Green regions are those where new snack bars containing insects were launched between January 2014 and May 2023. The greener the country, the more products were launched. Source: Own elaboration based on the data retrieved from Mintel Database, 2023.

**Table 1**  
Nutrient profile of regular and insect snack bars.

Nutrient	Unit	Value per 100 g	
		Regular snack bars	Insect snack bars
Energy value	kcal	399	410
Total Fat	g	11.8	19.3
Saturated Fat	g	n.a.	4.0
Carbohydrates	g	60.25	44.3
Total Fibers	g	7.0	11.1
Total Sugar	g	n.a.	27.2
Proteins	g	15.5	17.7
Sodium	mg	268	214

Source: Own elaboration based on the data retrieved from Mintel Database, 2023.

Note: The nutritional values for regular snack bars were calculated from the chemical composition of selected snack bars provided by (Constantin and Istrati, 2018)



**Fig. 3.** Word cloud representing the claims used on insect snack bar packaging. Note: A word cloud is a visual representation of word frequency and value. The word cloud was generated using <https://www.wordclouds.com/>. Source: Own elaboration based on the data retrieved from Mintel Database, 2023.

**4. Discussion**

This study investigated current market trends in edible insects, by performing a market analysis using Mintel’s GNPD (Solis, 2016), which

tracks new food product launches globally and has been previously used in studies examining markets for food products like plant-based meat alternatives (Andreani et al., 2023; Boukid et al., 2022). Our results revealed a growing market for healthy extruded snacks (Gomes et al., 2023). Specifically, the snack bars segment has expanded in recent years, driven by heightened consumer interest in eating healthier foods and maintaining good body fitness (Constantin and Istrati, 2018). In alignment with these findings, our research showed that the market for insect snack bars is growing as well. This trend is supported by previous research indicating that insect snack bars are considered the most appropriate insect-containing product by consumers (Ardoin and Priyawiwatkul, 2020). Furthermore, protein bars, in general, are perceived as suitable product carriers for proteins from both plant and animal origins (Banovic et al., 2018). These results suggest that the growing interest in health and fitness is driving the expansion of both traditional and insect-based snack bars, highlighting the potential for insect proteins to be integrated into mainstream health food products.

In agreement with previous research showing that crickets are the most used insects in insect-based processed foods (Boukid et al., 2022), our analysis found that house cricket (*Acheta domesticus*) is the most frequently employed insect in insect snack bars (93 %). This predominance of house crickets did not allow for an investigation into price variations across different insect species. However, the unit price of 2.56€ is comparable to the average price of 2.67€ per unit of snack bar sold in the United States in 2016 (Store Brands, 2016). The Mintel dataset did not provide the percentage of insects used in each product, which is a potentially significant factor in price determination, as prices are linked to the insect quantity in the product (Pippinato, Gasco, Vita, and T. Mancuso, 2020). Despite this limitation, the dataset did include the nutritional content and our analysis showed that insect snack bars are comparable to regular snack bars in terms of overall nutrient content. This finding aligns with previous research demonstrating that snack bars, with their high protein and fiber contents, offer consumers the necessary energy and nutritional benefits in a convenient, easy-to-store product (Constantin and Istrati, 2018). To address the dataset limitations and provide a more comprehensive evaluation, future research should consider purchasing, tasting, and evaluating these products based on their sensory characteristics and nutritional content. Such evaluations would enable a more critical analysis and comparison with other publications. Additionally, the constraints of the Mintel database highlight the need for in-depth analysis of specific macro and micronutrients, comparing regular snack bars with

insect-based alternatives. This approach would enhance understanding of the nutritional benefits and market potential of insect-based snack bars, offering valuable insights for consumers and producers.

Another relevant aspect highlighted in the results of the present work is the use of nutrient-related (e.g., “high protein”) and sustainable claims (e.g., “environmentally friendly”) in both the product packaging and the companies’ website. This strategic promotional engagement emphasizes the nutritional benefits and sustainability of the products appealing to health-conscious and environmentally aware consumers. This approach is particularly crucial in Western societies where insect consumption is not traditionally rooted in the diet, as highlighted by Hartmann et al. (2015). Their study demonstrated that while Chinese consumers rated insect-based foods more favorably, Germans showed a higher willingness to consume processed insect-based products over unprocessed ones (Hartmann et al., 2015). This underscores the importance of familiarizing Western consumers with insect-based foods through processed products, which can mitigate food neophobia and enhance acceptance. Although information alone is not enough to lead to lasting behavioral changes, previous research showed that providing information on these aspects could potentially increase consumers’ acceptance of insect-based food (Dagevos, 2021). Therefore, claims could prompt consumers to try insect foods and, potentially, help to overcome barriers such as food neophobia and disgust (Dagevos, 2021). However, as overcoming these barriers remains a critical challenge, especially in Western countries (Sogari et al., 2023), future studies should investigate what information would most likely influence consumers’ acceptance of insect-based food and explore the best way to deliver such information (e.g., “source of protein” vs. “insect protein”). In addition, no claims on the hedonistic aspects (e.g., taste) were identified in our analysis. One possible explanation for the lack of hedonistic claims on insect snack bars may be related to technological advancements in the sector – which permit the inclusion of insects with limited impact on sensory characteristics (Boukid et al., 2022) – and to the fact that, in snack bars specifically, any insect flavor is likely masked by dominant bar’s flavors, such as chocolate, peanut butter, or cinnamon. To further address the potential negative impact on sensory properties, producers should ensure a less gritty texture, a milder odor and flavor intensity, and a lighter color (so the impact on appearance is less noticeable) (Ribeiro et al., 2024). Nevertheless, as consumers’ acceptance of insect foods remains low (Barton, Richardson and McSweeney, 2020; Dupont and Fiebelkorn, 2020), further exploration of the hedonistic aspects could be important. As previously suggested (Puteri, Jahnke and Zander, 2023; Siddiqui et al., 2023), tasting activities (e.g., free sample strategy) and effective and simple advertising schemes are essential marketing strategies to influence consumers’ perceptions and preferences in this sector. Therefore, the open question of whether consumers are prepared to eat insects is still the most important for this industry to address. It will be important to identify what strategies work, especially when dealing with children who are going to be future consumers.

In general, information-based interventions on the benefits of eating insects have been found to have short-term effects (Wassmann, Siegrist and Hartmann, 2021); therefore, such messages could be appropriate at the packaging level as they might attract consumers to at least try the product.

In addition, it is particularly important to consider also ethical and environmental aspects of insect-based foods, which are complex and multifaceted. Thus, policy should be balanced with the need for ethical treatment of insects and sustainable environmental practices. Specifically, ethical aspects encompass considerations around animal welfare, cultural and social acceptance, and sustainability (EUROGROUP, 2023).

Ethical concerns also extend to respecting cultural dietary norms and ensuring consumer choice through transparent marketing (Videbæk and Grunert, 2020). Furthermore, regulators should consider the environmental benefits of insect farming, which include resource efficiency, low greenhouse gas emissions, waste reduction, and biodiversity impact (Muurmann et al., 2024). Finally, the economic impact on insect producers underscores the need to understand how new production systems could be compatible with existing systems and how insect producers could deliver cost-effective products (Limborg et al., 2018).

To the best of our knowledge, this is the first market research investigating new global launches of insect snack bars. However, it is important to acknowledge that while Mintel is a comprehensive database, it may not encompass all products and specific details. Additionally, the database lacks information on actual consumption trends, such as the number of products sold in the market. Despite these limitations, we think that our contribution makes a valuable addition by integrating Mintel data to extract important findings that are pertinent to policy-making and industry. Our results shed light that insect snack bars stand out as a viable alternative to regular snack bars, in terms of nutrition (Placentino et al., 2021), and may play a role in increasing consumers’ familiarity with edible insects, thus paving the way toward their acceptance.

## 5. Conclusions

This study represents a first effort to examine global launches of insect snack bars by offering a foundational understanding of the market dynamics and proposing strategic directions for future product development and marketing within this emerging food sector. The present study underscores the viability and nutritional value of insect bars as alternatives to traditional offerings, such as regular snack bars. Furthermore, it highlights the importance for companies to capitalize on health and sustainability claims through effective promotional and engagement strategies, while also considering the necessity to address taste preferences and overcome consumer neophobia. Additionally, the insights gained from this study can serve as valuable resources for manufacturers and retailers in crafting and promoting new insect-based product offerings. Policymakers may also benefit from the present study as a starting point to define future communications and regulatory strategies in this evolving market.

## Author contributions

All authors equally contributed to the present work.

## CRedit authorship contribution statement

**Giulia Andreani:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Giovanni Sogari:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Marija Banovic:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix

**Table A1**  
Search criteria considered in Mintel database.

Search Variable	Criteria
Category	"Food"
Sub-category	"Food"; "Drink"
Ingredient	"Tenebrio molitor"; "Alphitobius diaperinus"; "Mealworm"
Date Published	from January 2014 to May 2023
Region	"Across all regions/markets"

## References

- Agriculture and Agri-Food Canada. 2017. "Sales Value Forecast Of Fortified And Functional Energy And Nutrition Bars In The United Kingdom (UK) from 2010 to 2020\*." Statista. Available at: (<https://www.statista.com/statistics/717843/functional-snack-bars-market-value-united-kingdom-uk/>) [Accessed December 12, 2023].
- Alhujaili, A., Nocella, G., & Macready, A. (2023). Insects as food: Consumers Acceptance and Marketing. *Foods*, 12(4), 886 (Available at) (<https://www.mdpi.com/2304-8158/12/4/886/html>).
- Andreani, G., Sogari, G., Marti, A., Froidl, F., Dagevos, H., & Martini, D. (2023). Plant-based meat alternatives: Technological, nutritional, environmental, market, and social challenges and opportunities. *Nutrients*, 15(2).
- Ardoin, R., & Prinyawiwatkul, W. (2020). Product appropriateness, willingness to try and perceived risks of foods containing insect protein powder: A survey of U.S. consumers. *International Journal of Food Science & Technology*, 55(9), 3215–3226.
- Banovic, M., Arvola, A., Pennanen, K., Duta, D. E., Brückner-Gühmann, M., Lähteenmäki, L., & Grunert, K. G. (2018). Foods with increased protein content: A qualitative study on European consumer preferences and perceptions. *Appetite*, 125, 233–243.
- Banovic, M., Arvola, A., Pennanen, K., Duta, D. E., Sveinsdóttir, K., Sozer, N., & Grunert, K. G. (2022). A taste of things to come: Effect of temporal order of information and product experience on evaluation of healthy and sustainable plant-based products. *Frontiers in Nutrition*, 9.
- Barton, A., Richardson, C. D., & McSweeney, M. B. (2020). Consumer attitudes toward entomophagy before and after evaluating cricket (*Acheta domesticus*)-based protein powders. *Journal of Food Science*, 85(3), 781–788.
- Bisconsin-Júnior, A., Rodrigues, H., Behrens, J. H., Lima, V. S., da Silva, M. A. A. P., de Oliveira, M. S. R., Januário, L. A., Deliza, R., Netto, F. M., & Mariutti, L. R. B. (2020). Examining the role of regional culture and geographical distances on the representation of unfamiliar foods in a continental-size country. *Food Quality and Preference*, 79, Article 103779.
- Boukid, F., Sogari, G., & Rosell, C. M. (2022). *Edible insects as foods: Mapping scientific publications and product launches in the global market (1996-2021)*. ". <https://doi.org/10.3920/JIFF2022.0060:1-16>.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2019). Thematic analysis. *Handbook of Research Methods in Health Social Sciences*, 843–860 (Available at) ([https://link.springer.com/referenceworkentry/10.1007/978-981-10-5251-4\\_103](https://link.springer.com/referenceworkentry/10.1007/978-981-10-5251-4_103)).
- Chen, S., Liu, X., Yan, J., Hu, G., & Shi, Y. (2021). Processes, benefits, and challenges for adoption of blockchain technologies in food supply chains: A thematic analysis. *Information Systems and e-Business Management*, 19(3), 909–935 (Available at) (<https://link.springer.com/article/10.1007/s10257-020-00467-3>).
- Cicatiello, C., Vitali, A., & Lacetera, N. (2020). How does it taste? Appreciation of insect-based snacks and its determinants. *International Journal of Gastronomy and Food Science*, 21, Article 100211.
- Commission Regulation (EU). 2012. EU Commission Regulation No 1047/2012 of 8 November 2012 amending Regulation (EC) No 1924/2006 with regard to the list of nutrition claims Text with EEA relevance.
- Committee on Agriculture and Rural Development, European protein strategy, 2023.
- Constantin, O. E., & Istrati, D. I. (2018). In V. Lagouri (Ed.), *Functional Properties of Snack Bars*. Rijeka: IntechOpen.
- Dagevos, H. (2021). A literature review of consumer research on edible insects: recent evidence and new vistas from 2019 studies. *Journal of Insects as Food and Feed*, 7(3), 249–259.
- Dupont, J., & Fiebelkorn, F. (2020). Attitudes and acceptance of young people toward the consumption of insects and cultured meat in Germany. *Food Quality and Preference*, 85, Article 103983.
- EUROGROUP. 2023. "Scientific declaration on insect sentience and welfare." Available at: ([https://www.eurogroupforanimals.org/files/eurogroupforanimals%2023-11/20112023\\_scientific%20declaration%20on%20insect%20sentience%20and%20welfare\\_scientific%20statement\\_efa\\_en\\_0.pdf](https://www.eurogroupforanimals.org/files/eurogroupforanimals%2023-11/20112023_scientific%20declaration%20on%20insect%20sentience%20and%20welfare_scientific%20statement_efa_en_0.pdf)) [Accessed June 28, 2024].
- European Commission. 2023. "Approval of fourth insect as a Novel Food." Available at: ([https://food.ec.europa.eu/safety/novel-food/authorisations/approval-insect-novel-food\\_en](https://food.ec.europa.eu/safety/novel-food/authorisations/approval-insect-novel-food_en)) [Accessed December 27, 2023].
- Gomes, K. S., Berwian, G. F., Batistella, V. M. C., Bender, L. E., Reinehr, C. O., & Colla, L. M. (2023). Nutritional and technological aspects of the production of proteic extruded snacks added of novel raw materials. *Food and Bioprocess Technology*, 16(2), 247–267.
- Gómez-Corona, C., & Valentin, D. (2023). The crispy cricket – Attitudes, habits, and tradition in insect consumption. *Food Quality and Preference*, 110, Article 104960.
- Hartmann, C., Shi, J., Giusto, A., & Siegrist, M. (2015). The psychology of eating insects: A cross-cultural comparison between Germany and China. *Food Quality and Preference*, 44, 148–156.
- Hémar-Nicolas, V., Thomas, F., Gallen, C., & Pantin-Sohier, G. (2024). Realistic or not? The impact of packaging images on the acceptance of insect-based food products. *Journal of Product and Brand Management Ahead-of-print (Ahead-of-print)*.
- IPIFF. 2020. "Edible insects on the European market."
- Limborg, M. T., Alberdi, A., Kodama, M., Roggenbuck, M., Kristiansen, K., & Gilbert, M. T. P. (2018). Applied hologenomics: Feasibility and potential in aquaculture. *Trends in Biotechnology*, 36(3), 252–264.
- 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.
- Menozi, D., Sogari, G., Veneziani, M., Simoni, E., & Mora, C. (2017). Eating novel foods: An application of the theory of planned behaviour to predict the consumption of an insect-based product. *Food Quality and Preference*, 59, 27–34.
- Montanari, F., Pinto de Moura, A., & Miguel Cunha, L. (2021). The Global Market of Insects as Food and Feed. In F. Montanari, A. Pinto de Moura, & L. M. Cunha (Eds.), *Production and Commercialization of Insects as Food and Feed* (pp. 19–27). Cham: Springer International Publishing.
- Muurmann, A. T., Banovic, M., Gilbert, M. T. P., Sogari, G., Limborg, M. T., Sicheritz-Pontén, T., & Bahrndorff, S. (2024). Framework for valorizing waste- and by-products through insects and their microbiomes for food and feed. *Food Research International*, 187, Article 114358.
- Pippinato, L., Gasco, L., Di Vita, G., & Mancuso, T. (2020). "Current scenario in the European edible-insect industry: A preliminary study. *Journal of Insects as Food and Feed*, 6(4), 371–381.
- Placentino, U., Sogari, G., Viscecchia, R., De Devitiis, B., & Monacis, L. (2021). The new challenge of sports nutrition: Accepting insect food as dietary supplements in professional athletes. *Foods*, 10(5).
- Puteri, B., Jahnke, B., & Zander, K. (2023). Booming the bugs: How can marketing help increase consumer acceptance of insect-based food in Western countries? *Appetite*, 187, Article 106594.
- 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(1), Article e13247 (Available at) (<https://onlinelibrary.wiley.com/doi/full/10.1111/1541-4337.13247>).
- Rybak, G., Burton, S., Johnson, A. M., & Berry, C. (2021). Promoted claims on food product packaging: Comparing direct and indirect effects of processing and nutrient content claims. *Journal of Business Research*, 135, 464–479.
- Siddiqui, S. A., Tettey, E., Yunusa, B. M., Ngah, N., Debrah, S. K., Yang, X., Fernando, I., Povetkin, S. N., & Shah, M. A. (2023). Legal situation and consumer acceptance of insects being eaten as human food in different nations across the world—A comprehensive review. *Comprehensive Reviews in Food Science and Food Safety*, 22(6), 4786–4830 (Available at) (<https://onlinelibrary.wiley.com/doi/full/10.1111/1541-4337.13243>).
- Sogari, G., Amato, M., Palmieri, R., Saadoun, J. H., Formici, G., Verneau, F., & Mancini, S. (2023). The future is crawling: Evaluating the potential of insects for food and feed security. *Current Research in Food Science*, Article 100504.
- Solis, E. (2016). Mintel Global New Products Database (GNPD). *Journal of Business & Finance Librarianship*, 21(1), 79–82.
- Store Brands. 2016. "Average price per unit of nutrition and snack bars in the United States in 2016, by segment (in U.S. dollars) [Graph]." Statista. Available at: (<https://www.statista.com/statistics/645181/average-unit-pri>) [Accessed December 11, 2023].
- van Huis, A., J. Van Itterbeeck, H. Klunder, E. Mertens, A. Halloran, G. Muir, and P. Vantomme. 2013. *Edible Insects. Future Prospects for Food and Feed Security*.

- Verneau, F., La Barbera, F., Kolle, S., Amato, M., Del Giudice, T., & Grunert, K. (2016). The effect of communication and implicit associations on consuming insects: An experiment in Denmark and Italy. *Appetite*, 106, 30–36.
- Videbæk, P. N., & Grunert, K. G. (2020). Disgusting or delicious? Examining attitudinal ambivalence towards entomophagy among Danish consumers. *Food Quality and Preference*, 83, Article 103913.
- Wassmann, B., Siegrist, M., & Hartmann, C. (2021). Correlates of the willingness to consume insects: A meta-analysis. *Journal of Insects as Food and Feed*, 7(5), 909–922. ([https://brill.com/view/journals/jiff/7/5/article-p909\\_28.xml](https://brill.com/view/journals/jiff/7/5/article-p909_28.xml)) [Accessed June 28, 2024].