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Perception of meat alternatives compared to meat: Differences between meat eaters and reducetarians[1]

Jak są postrzegane alternatywy mięsa? Porównanie opinii osób jedzących mięso i ograniczających jego spożycie

Abstract

Growing ethical, environmental, and health concerns related to meat consumption have increased interest in alternative protein sources, such as plant-based meat alternatives (PBMAs), insect-based foods, and lab-grown meat. This study examined how Polish consumers perceive these three categories of meat substitutes in comparison to conventional meat and how these perceptions differ between meat eaters and reducetarians (individuals who intentionally limit meat consumption). A representative sample of 1,016 Polish adults completed an online survey evaluating meat alternatives on several dimensions. Overall, PBMAs received the most favourable evaluations, lab-grown meat was viewed ambivalently, and insect-based foods faced the strongest perceptual barriers. Dietary habits significantly influenced perceptions: reducetarians assessed all substitutes more positively than meat eaters, indicating greater openness to alternative proteins. These findings highlight substantial variation in how different meat alternatives are received by consumers and underscore the importance of addressing both sensory expectations and emotional responses in promoting meat alternatives.

Keywords

meat substitutes, consumer perception, sustainable diet, plant-based meat alternatives, lab-grown meat, insect-based food, reducetarianism

Streszczenie

Rosnące obawy etyczne, środowiskowe i zdrowotne związane ze spożyciem mięsa przyczyniły się do wzrostu zainteresowania alternatywnymi źródłami białka, takimi jak roślinne zamienniki mięsa (PBMAs), produkty na bazie owadów oraz mięso hodowane komórkowo. Celem badania było sprawdzenie, jak polscy konsumenci postrzegają te trzy kategorie alternatyw mięsa w porównaniu z mięsem konwencjonalnym oraz jak różnią się te oceny między osobami jedzącymi mięso a reduktarianami (osobami celowo ograniczającymi spożycie mięsa). Badanie przeprowadzono na reprezentatywnej próbie 1016 dorosłych Polaków, którzy wypełnili internetową ankietę oceniającą różne alternatywy mięsa w wielu wymiarach. Roślinne zamienniki mięsa (PBMAs) uzyskały najbardziej pozytywne oceny, mięso hodowane komórkowo było postrzegane ambiwalentnie, natomiast żywność z owadów oceniano najgorzej. Dieta okazała się również ważnym czynnikiem różnicującym. Wyniki podkreślają znaczące zróżnicowanie w odbiorze różnych substytutów mięsa oraz konieczność uwzględniania zarówno oczekiwań sensorycznych, jak i reakcji emocjonalnych w działaniach promujących produkty zastępujące mięso.

Słowa kluczowe

zamienniki mięsa, postawy konsumentów, zrównoważona dieta, alternatywy roślinne, mięso hodowane komórkowo, jedzenie z owadów, reduktarianizm

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Introduction

While meat consumption continues to be a fundamental part of the human diet, it is facing growing concerns from consumers. Although the number of people who completely exclude meat from their diets (vegans and vegetarians) is still relatively small – around 10% in various European countries – about 40% of consumers report that, while they do eat meat, they are actively trying to reduce their intake (SmartProtein, 2021). These shifts are primarily driven by ethical concerns, such as animal welfare and the environmental impact of meat production, as well as health considerations related to the negative effects of meat consumption (de Oliveira Padilha et al., 2022; Szymkowiak et al., 2023).

As more people choose to reduce or eliminate meat from their diets, the market for meat alternatives has been steadily growing. Some of these alternatives have been available on the European market for quite some time, such as plant-based meat products, which are easily found in supermarkets. Others, like insect-based foods, occupy a niche market and are only available in select stores. Meanwhile, lab-grown meat is still awaiting mass production and regulatory approval before it can be sold (Caputo et al. 2024; Sikora & Rzymski, 2023; Szulc, 2023). Despite the efforts of producers, the market success of these products will largely depend on how consumers perceive them and whether they choose to incorporate them into their diets – either as a replacement for meat or as an additional option.

The aim of our study was to explore attitudes of Polish consumers towards plant-based meat alternatives, insect-based foods, and lab-grown meat, and how they compare to traditional meat on various dimensions.

The concerns regarding meat consumption

In recent years, there has been a significant increase in the demand for animal-based food products, driven largely by rising individual incomes and population growth. However, the current imbalance between plant and animal protein in the human diet raises serious environmental, ethical, and health concerns (De Boer & Aiking, 2018). Industrial-scale animal food production has profound environmental impacts, including contributing to climate change, biodiversity loss, and changes in land use (Aiking, 2011; Grossi et al., 2019). Additionally, high levels of meat consumption lead to another critical issue: animal suffering while slaughtered for meat (Hampton et al. 2021). Lastly, excessive consumption of meat can lead to adverse health outcomes, including cardiovascular disease, weight gain, and several cancers, particularly colorectal cancer (Guasch-Ferre, 2019; Gonzales et al., 2020). There are also concerns regarding the use of antibiotics and hormones in livestock production, as these substances can leave residues that enter the human food chain (Hirpessa et al., 2020).

Growing awareness of the negative impacts of consuming meat has led to "meat paradox" – psychological conflict between people's dietary preference for meat and their moral response to animal suffering (Loughnan et al., 2014). One way to alleviate this conflict is by changing behaviour, such as reducing or eliminating the consumption of animal products and opting for alternative protein sources instead. Although the number of people choosing to completely eliminate meat from their diet is still small, the number of those choosing to reduce the amount of meat they eat is increasing. This approach is characterized by a flexible reduction in meat intake, which varies among individuals based on personal goals, cultural influences, and dietary preferences (Bianchi et al., 2018). Reducetarianism encompasses a spectrum of eating patterns, ranging from moderate reductions in meat consumption to primarily plant-based diets with occasional inclusion of animal products. This dietary movement does not require strict adherence to plant-based eating but rather encourages mindful reductions of meat. Reducetarians may adopt various strategies to decrease meat consumption, such as practicing meatless days, reducing portion sizes of animal products or choosing meat alternatives (Onvezen & Dagevos, 2024).

In response to concerns about meat production and consumption several efforts have been made to increase the production of different meat alternatives. Among them, plant-based meat analogues, insects-based food, and cultured meat are garnering the interest of the markets, although cultured meat is still under development for commercialization (Sadler, 2004; Gastaldello et al. 2022). These alternatives, unlike traditional vegetarian foods designed for specific dietary restrictions (e.g., vegans and vegetarians), target a much broader consumer market – including reducetarians and even meat eaters.

Meat alternatives – new options on the market

Recently, a new wave of plant-based meat alternatives (PBMAs) has been developed using different ingredients and undergoing more extensive processing to enhance the sensory experience and mimic the characteristics of meat, such as appearance and taste. Technologies like extrusion have enabled the creation of products made from

extracted pea or oat protein, which even replicate the structure of meat.

Additionally, the names of these products (e.g., plant-based sausages, plant-based burgers) are clearly intended to resemble meat and appeal to meat-loving consumers (Andreani et al., 2023). Meat industry lobbyists have long pushed for restrictions, arguing that terms like "burger" should be reserved for animal-based products (such a legal provision was introduced in France[2]). However, recently the European Court of Justice ultimately ruled that producers of plant-based meat alternatives can use terms like "burger," "ham," and "sausage" for their products (EurLex, 2024).

Compared to meat, plant-based alternatives have a relatively small market share. This may be attributed to the high degree of processing in plant-based meat alternatives (PBMAs), which presents both advantages and challenges. On one hand, this processing enables these products to replicate the sensory characteristics of meat; on the other hand, it can discourage consumers who perceive them as too artificial (Andreani et al., 2023). Similarly, the names of these products can serve as a double-edged sword – they may entice consumers to try items like "plant-based sausage," but they can also heighten consumer expectations regarding how closely these products resemble traditional meat (which may be difficult to fulfil – Adamczyk & Maison, 2019).

Insect-based food faces even greater difficulty breaking into the European market, despite its potential benefits for both the environment and human health. Rearing edible insects requires significantly less water and space compared to traditional livestock. Moreover, the greenhouse gas emissions produced are considerably lower (Lucas et al., 2020). In addition to these significant advantages, incorporating edible insects into a balanced diet could provide a sustainable source of food, thanks to their high feed conversion rate. Furthermore, studies indicate that edible insect species offer considerable nutritional value, serving as an excellent source of protein, fat, vitamins, and minerals. Although edible insects are a valuable source of nutrients and minerals, in Western societies eating insects arouses many concerns mainly due to strong feelings of disgust (e.g., Mlček et. al, 2000; Modlinska et al., 2021).

The closest alternative to traditional meat is laboratory meat, also referred to as cultured meat, cell-based meat, in vitro meat, or clean meat, is designed to replicate the sensory and nutritional qualities of conventional meat, catering to the demand for meat-based diets among consumers (Chong et al., 2022). The key distinction lies in its production method, which involves culturing adult muscle stem cells within a collagen matrix sourced from either live or deceased animals. This process provides the necessary energy for the cells to grow and develop into skeletal muscle tissue strips. Additionally, fat cells are co-cultured to enhance the flavour, texture, and tenderness of the meat. The resulting tissue can be processed and packaged for consumption (Padhila et al., 2021).

Lab-grown meat products first became available to consumers in Singapore in late 2020, and the first commercial lab-grown meat factory opened in Israel in 2021. However, it has yet to reach the European market, as regulatory frameworks are still being established. This raises the question of whether lab-grown meat will gain consumer approval in Europe and if people will view it as comparable to traditional meat (Sikora & Rzymski, 2023).

Taken together, previous research highlights that acceptance of meat alternatives depends on a combination of sensory expectations (particularly taste), perceived naturalness and degree of processing, emotional responses such as disgust, and beliefs about environmental and animal-welfare benefits. However, the relative importance of these factors varies considerably across different types of alternatives: plant-based products are often judged through the lens of processing and sensory similarity to meat, insect-based foods are primarily hindered by disgust, and cultured meat raises concerns related to technological novelty and perceived unnaturalness. Despite these insights, existing studies rarely compare these categories directly or assess them using consistent evaluative criteria within the same cultural context. As a result, they provide only a partial view of how consumers understand these products when encountered as elements of the same emerging protein landscape. This fragmentation makes it difficult to determine how different alternatives are perceived in relation to one another or how their distinct characteristics might collectively influence the transition away from conventional meat. Comparative, integrative analyses are therefore needed to offer a more coherent picture of consumer perceptions. While our study does not aim to exhaust this complex topic, situating it within a shared analytical framework and cultural context contributes to a more integrated understanding of the evolving market for alternative proteins.

The research was conducted in Poland, a country with deeply rooted culinary traditions centred on conventional meat, high per-capita meat consumption, and strong cultural attachments to meat as a symbol of identity and hospitality, yet simultaneously experiencing rapid growth in its plant-based food sector and rising interest in novel protein technologies (Borusiak et al., 2022). The main objective of our study was to examine how three very different meat alternatives (plant-based, insect-based, and lab-grown meat) are

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perceived by Poles in relation to traditional meat. The second distinctive aspect of our study was the differentiation between reducetarians and meat eaters, two consumer groups that may approach meat alternatives with different motivations, expectations, and levels of openness to dietary change. We explored in our research how these groups evaluate three meat alternatives – plant-based, insect-based, and lab-grown meat – across dimensions reflecting potential benefits (such as taste, healthiness, and environmental or animal welfare advantages) and barriers (such as perceptions of artificiality, harmfulness, fear, or being "against nature"). We were particularly interested in how these evaluations differ when compared directly to conventional meat.

Method – sample and procedure

A representative sample of the Polish general population (N = 1016) took part in the survey. It was conducted online by the Pollster Research Panel, a company specialising in large sample polling with previous experience in running studies for academic research purposes. Data was obtained through an online survey conducted on a nationwide random-quota sample of Poles. The quotas on gender, age, settlement size, and education were based on how the population of Poland is represented among the nation's internet users. Participants received credit points for their participation, which they could exchange for gifts.

The sample consisted of 51% women and 49% men, with a mean age of 45 years (SD = 16.01). Fifty percent of the participants lived in villages or small towns, 20% in medium-sized cities, and 30% in cities with more than 10,000 inhabitants. Additionally, 32% of participants had primary or vocational education, 39% had secondary education, and 29% had a university degree. Regarding diet, 52% of respondents declared that they consumed meat without any restrictions, 45% tried to reduce meat consumption, and 3% were veg*ans (vegetarians or vegans). Due to the small number of veg*ans in the sample, we combined them with people who reduce meat consumption into one group named "reducetarians" for the purpose of the analysis. The decision to combine these groups is also theoretically justified, as prior studies indicate that meat abstainers and meat reducers often share similar health-, environment- and animal-welfare-related motivations for avoiding or reducing meat (see e.g. Dagevos, 2021)

Participants were asked to compare three meat alternatives (plant-based meat, insect-based meat, and lab-grown meat) to traditional meat on a scale from –2 to 2, where –2 meant "less than meat," 0 meant "the same as meat," and 2 meant "more than meat." The evaluation included four positive attributes (tasty, healthy, animal-friendly, environmentally friendly) and four negative attributes (artificial, harmful, disgusting, frightening).

The study was conducted in accordance with the Declaration of Helsinki. Participation in the study was voluntary, and participants provided informed consent. This research was approved by the Research Ethics Committee of University of Warsaw (approval numbers: 4/06/2022).

Results

Perception of PBMA, lab-grown meat, and insect-based food compared to meat

To analyse how PBMAs, lab-grown meat, and insect-based food were perceived in comparison to meat, one-sample t-tests was conducted with meat as the reference point.

The results indicated that PBMA was perceived as less tasty than meat, but as healthier, more animal-friendly, and more environmentally friendly than meat. Additionally, the PBMA was also evaluated as less harmful, less disgusting and less frightening than meat. However, PBMA was also perceived as more artificial than meat, (see Figure 1 and Table 1).

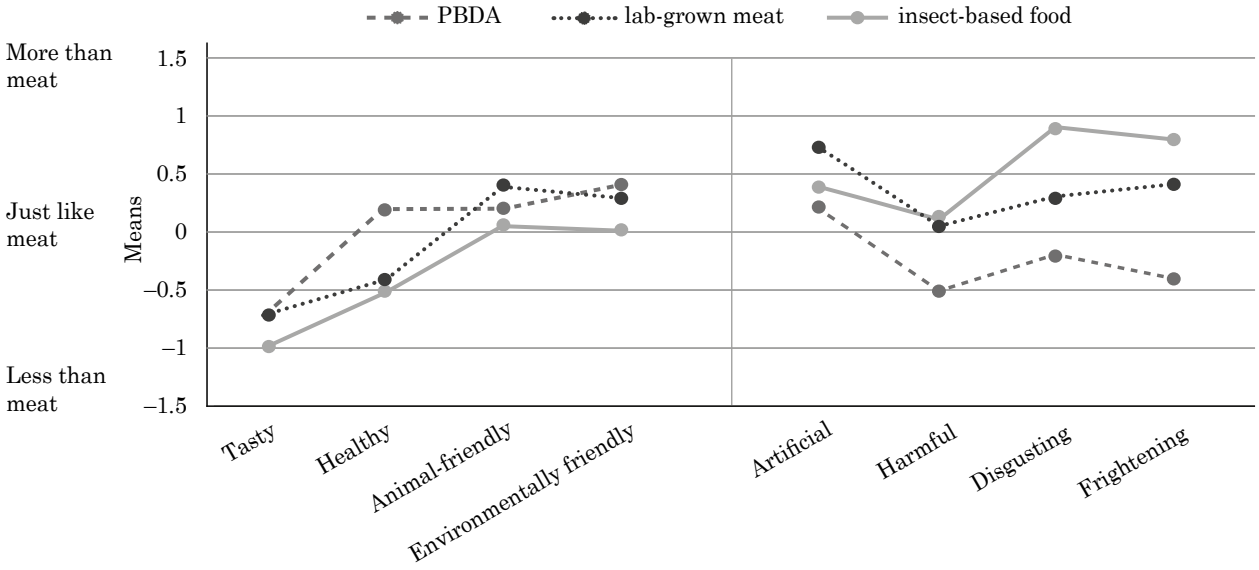
Lab-grown meat was perceived as less tasty and less healthy than meat, but as more animal-friendly, and more environmentally friendly than meat. Additionally, the lab-grown meat was evaluated as more disgusting, more frightening and more artificial. It was also perceived as equally harmful as meat (see Figure 1 and Table 1).

Insect-based food was perceived as less tasty and less healthy than meat, but as more animal-friendly than meat. Additionally, the insect-based food was evaluated as more disgusting, more frightening and more artificial, than meat, also as more harmful than meat. It was also perceived as equally environmentally friendly as meat (see Figure 1 and Table 1).

Perception of PBMA, lab-grown meat, and insect-based food comparing to meat – differences between meat eaters and reducetarians

To analyse how PBMAs, lab-grown meat, and insect-based food were perceived in comparison to meat, and to assess how these comparisons emerged within each dietary group, one-sample t-tests with meat as the reference point were conducted separately for reducetarians and meat eaters.

Figure 1. The perception of meat alternatives (PBMA, lab-grown meat, insect-based food) in relation to meat



Source: own elaboration.

Table 1. Evaluation of meat alternatives across various dimensions compared to meat

Attribute	PBMA	Lab-grown meat	Insect-based food
Tasty	$t_{(1015)} = -19.31$, $p < 0.001$, $d = -0.6$ $M = -0.66$ ($SD = 1.08$)	$t_{(1015)} = -21.32$, $p < 0.00$, $d = -0.66$ $M = -0.72$ ($SD = 1.08$)	$t_{(1015)} = -30.08$, $p < 0.001$ $d = -0.94$ $M = -1.05$ ($SD = 1.12$)
Healthy	$t_{(1015)} = 4.95$, $p < 0.001$, $d = 0.15$ M= 0.17 ($SD = 1.14$)	$t_{(1015)} = -11.71$, $p < 0.001$ $d = -0.36$ $M = -0.42$ ($SD = 1.14$)	$t_{(1015)} = -12.87$, $p < 0.001$ $d = -0.4$ $M = -0.48$ ($SD = 1.2$)
Animal-friendly	$t_{(1015)} = 5.16$, $p < 0.001$, $d = 0.16$ $M = 0.22$ ($SD = 1.36$)	$t_{(1015)} = 8.82$, $p < 0.001$ $d = 0.27$ $M = 0.37$ ($SD = 1.35$)	$t_{(1015)} = 2.12$, $p = 0.017$ $d = 0.06$ $M = 0.08$ ($SD = 1.29$)
Environmentally friendly	$t_{(1015)} = 10.79$, $p < 0.001$, $d = 0.33$ $M = 0.40$ ($SD = 1.2$)	$t_{(1015)} = 6.83$, $p < 0.001$ $d = 0.21$ $M = 0.28$ ($SD = 1.31$)	$t_{(1015)} = 1.02$, $p = 0.154$ $d = 0.3$ $M = 0.04$ ($SD = 1.25$)
Artificial	$t_{(1015)} = 5.5$, $p < 0.001$, $d = 0.17$ $M = 0.22$ ($SD = 1.31$)	$t_{(1015)} = 17.61$, $p < 0.001$ $d = 0.55$ $M = 0.74$ ($SD = 1.34$)	$t_{(1015)} = 8.07$, $p < 0.001$ $d = 0.27$ $M = 0.36$ ($SD = 1.35$)
Harmful	$t_{(1015)} = -14.23$, $p < 0.001$, $d = -0.45$ $M = -0.51$ ($SD = 1.2$)	$t_{(1015)} = 1.38$, $p = 0.08$ $d = 0.04$ $M = 0.05$ ($SD = 1.24$)	$t_{(1015)} = 2.91$, $p = 0.002$ $d = 0.09$ $M = 0.11$ ($SD = 1.26$)
Disgusting	$t_{(1015)} = -3.9$, $p < 0.001$, $d = -0.12$ $M = -0.16$ ($SD = 1.3$)	$t_{(1015)} = 6.65$, $p < 0.001$ $d = 0.2$ $M = 0.28$ ($SD = 1.3$)	$t_{(1015)} = 20.04$, $p < 0.001$ $d = 0.62$ $M = 0.87$ ($SD = 1.38$)
Frightening	$t_{(1015)} = -9.09$, $p < 0.001$, $d = -0.28$ $M = -0.36$ ($SD = 1.29$)	$t_{(1015)} = 8.28$, $p < 0.001$ $d = 0.26$ $M = 0.36$ ($SD = 1.38$)	$t_{(1015)} = 17.95$, $p < 0.001$ $d = 0.56$ $M = 0.79$ ($SD = 1.4$)

Source: own elaboration.

Figure 2. Perception of PBMA based on dietary preferences (reducetarians vs. meat eaters)

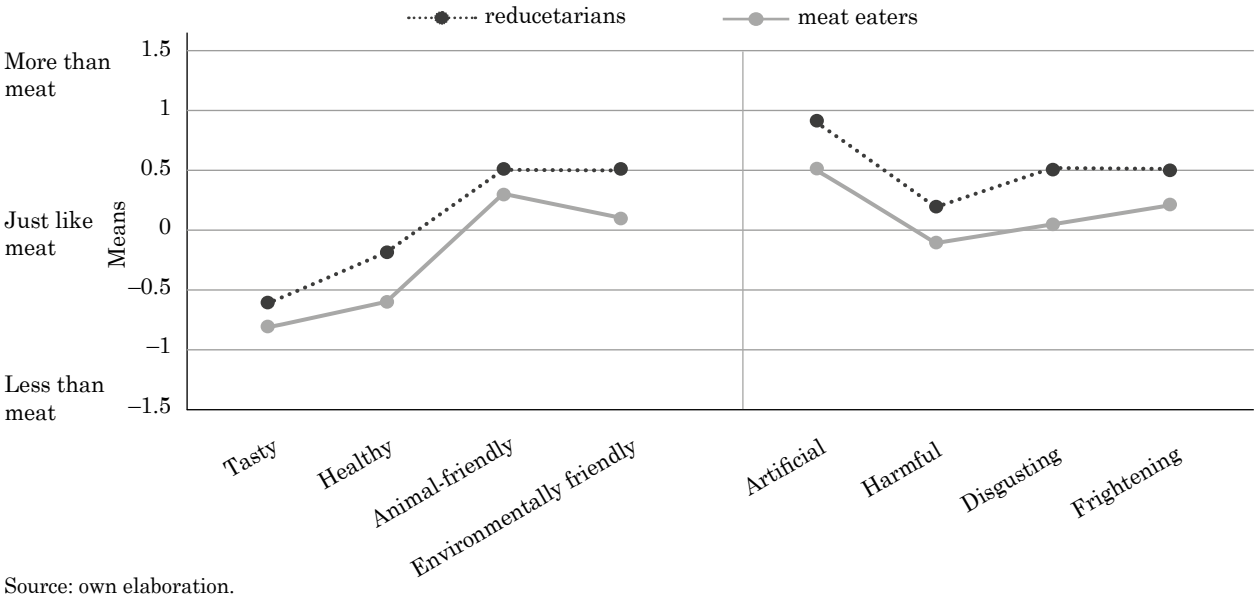
Source: own elaboration.

Table 2. Evaluation of PBMA compared to meat across various dimensions in groups of different dietary preferences

Attribute	Meat eaters	Reducetarians
Tasty	$t_{(524)} = -20.24$, $p < 0.001$, d = –0.88 $M = -0.90$ ($SD = 1.02$)	$t_{(490)} = -8.31$, $p < 0.001$, $d = -0.36$ $M = -0.39$ ($SD = 1.09$)
Healthy	$t_{(524)} = -2.1$, $p = 0.018$, $d = -0.09$ $M = -0.10$ ($SD = 1.14$)	$t_{(490)} = 9.9$, $p < 0.001$, $d = 0.44$ $M = 0.48$ ($SD = 1.07$)
Animal-friendly	$t_{(524)} = 1.68$, $p = 0.047$, $d = -0.07$ $M = 0.10$ ($SD = 1.37$)	$t_{(490)} = 5.76$, $p < 0.001$, $d = 0.26$ $M = 0.35$ ($SD = 1.34$)
Environmentally friendly	$t_{(524)} = 2.85$, $p = 0.002$, $d = 0.12$ $M = 0.15$ ($SD = 1.2$)	$t_{(490))} = 13.28$, $p < 0.001$, $d = 0.5$ $M = 0.68$ ($SD = 1.14$)
Artificial	$t_{(524)} = 7.86$, $p < 0.001$, $d = 0.34$ $M = 0.44$ ($SD = 1.31$)	$t_{(490))} = -0.21$, $p = 0.415$, $d = -0.01$ $M = -0.01$ ($SD = 1.26$)
Harmful	$t_{(524)} = -4.82$, $p < 0.001$, $d = -0.21$ $M = -0.24$ ($SD = 1.14$)	$t_{(490)} = -16.52$, $p < 0.001$, $d = -0.84$ $M = -0.80$ ($SD = 1.07$)
Disgusting	$t_{(524)} = 2.82$, $p = 0.005$, $d = 0.12$ $M = 0.15$ ($SD = 1.28$)	$t_{(490)} = -8.9$, $p < 0.001$, $d = -0.49$ $M = -0.50$ ($SD = 1.26$)
Frightening	$t_{(524)} = -1.01$, $p = 0.311$, $d = -0.04$ $M = -0.05$ ($SD = 1.29$)	$t_{(490)} = -12.88$, $p < 0.001$, $d = -0.67$ $M = -0.70$ ($SD = 1.20$)

Source: own elaboration.

Figure 3. Perception of lab-grown meat based on dietary preferences (reducetarians vs. meat eaters)



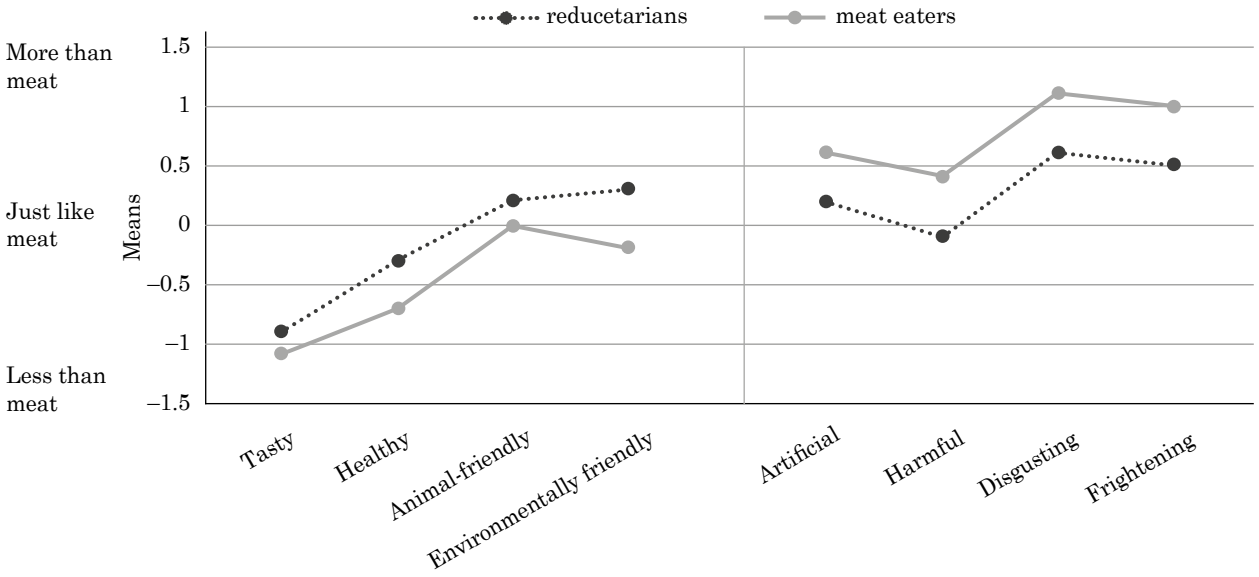
Source: own elaboration.

Table 3. Evaluation of lab-grown meat compared to meat across various dimensions in groups of different dietary preferences

Attribute	Meat eaters	Reducetarians
Tasty	$t_{(524)} = -17.81$, $p < 0.001$, $d = -0.77$ $M = -0.85$ ($SD = 1.09$)	$t_{(490)} = -12.36$, $p < 0.001$, $d = -0.55$ $M = -0.58$ ($SD = 1.05$)
Healthy	$t_{(524)} = -12.16$, $p < 0.001$, $d = -0.53$ $M = -0.59$ ($SD = 1.12$)	$t_{(490)} = -4.55$, $p < 0.001$, $d = -0.2$ $M = -0.23$ ($SD = 1.14$)
Animal-friendly	$t_{(524)} = 5.76$, $p < 0.001$, $d = 0.12$ $M = 0.29$ ($SD = 1.36$)	$t_{(490)} = 4.92$, $p < 0.001$, $d = 0.34$ $M = 0.46$ ($SD = 1.34$)
Environmentally friendly	$t_{(524)} = 1.94$, $p = 0.026$, $d = 0.08$ $M = 0.11$ ($SD = 1.35$)	$t_{(490)} = 8.15$, $p < 0.001$, $d = 0.36$ $M = 0.46$ ($SD = 1.25$)
Artificial	$t_{(524)} = 16.93$, $p < 0.001$, $d = 0.73$ $M = 0.95$ ($SD = 1.28$)	$t_{(490)} = 8.39$, $p < 0.001$, $d = 0.37$ $M = 0.51$ ($SD = 1.36$)
Harmful	$t_{(524)} = 3.97$, $p < 0.001$, $d = 0.17$ $M = 0.21$ ($SD = 1.24$)	$t_{(490)} = -2.14$, $p = 0.016$, $d = -0.09$ $M = -0.11$ ($SD = 1.22$)
Disgusting	$t_{(524)} = 8.96$, $p < 0.001$, $d = 0.39$ $M = 0.50$ ($SD = 1.28$)	$t_{(490)} = .69$, $p = 0.245$, $d = 0.03$ $M = 0.04$ ($SD = 1.36$)
Frightening	$t_{(524)} = 9.11$, $p < 0.001$, $d = 0.39$ $M = 0.54$ ($SD = 1.35$)	$t_{(490)} = 5.76$, $p < 0.001$, $d = 0.12$ $M = 0.16$ ($SD = 1.39$)

Source: own elaboration.

Figure 4. Perception of insect-based food based on dietary preferences



Source: own elaboration.

Table 4. Evaluation of insect-based food compared to meat across various dimensions in groups of different dietary preferences

Attribute	Meat eaters	Reducetarians
Tasty	$t_{(524)} = -24.51$, $p < 0.001$, $d = -1.07$ $M = -1.19$ ($SD = 1.11$)	$t_{(490)} = -18.14$, $p < 0.001$, $d = -0.81$ $M = -0.91$ ($SD = 1.12$)
Healthy	$t_{(524)} = -13.14$, $p < 0.001$, $d = -0.57$ $M = 0.67$ ($SD = 1.17$)	$t_{(490)} = -5.26$, $p < 0.001$, $d = -0.23$ $M = -0.28$ ($SD = 1.2$)
Animal-friendly	$t_{(524)} = -0.2$, $p = 0.420$, $d = -0.009$ $M = 0.01$ ($SD = 1.3$)	$t_{(490)} = 3.29$, $p = 0.001$, $d = 0.14$ $M = 0.19$ ($SD = 1.28$)
Environmentally friendly	$t_{(5245)} = -3.11$, $p < 0.001$, $d = -0.13$ $M = 0.16$ ($SD = 1.24$)	$t_{(490)} = 4.75$, $p < 0.001$, $d = 0.12$ $M = 0.06$ ($SD = 1.32$)
Artificial	$t_{(524)} = 9.66$, $p < 0.001$, $d = 0.42$ $M = 0.56$ ($SD = 1.33$)	$t_{(490)} = 2.69$, $p = 0.004$, $d = 0.03$ $M = 0.16$ ($SD = 1.34$)
Harmful	$t_{(524)} = 6.82$, $p < 0.001$, $d = 0.29$ $M = 0.36$ ($SD = 1.24$)	$t_{(490)} = -2.76$, $p = 0.006$, $d = -0.12$ $M = -0.15$ ($SD = 1.24$)
Disgusting	$t_{(524)} = -19.68$, $p < 0.001$, $d = 0.85$ $M = 1.09$ ($SD = 1.27$)	$t_{(490)} = 9.58$, $p < 0.001$, $d = 0.34$ $M = 0.62$ ($SD = 1.45$)
Frightening	$t_{(524)} = 18.05$, $p < 0.001$, $d = 0.78$ $M = 1.02$ ($SD = 1.3$)	$t_{(490)} = 8.16$, $p < 0.001$, $d = 0.36$ $M = 0.53$ ($SD = 1.32$)

Source: own elaboration.

Reducetarians perceived PBMA as healthier, more animal-friendly and more environmentally friendly than meat, but as less tasty than meat. Additionally, the PBMA was evaluated by reducetarians as less disgusting, less frightening, and less harmful than meat, and just as artificial as meat (see Figure 2 and Table 2).

Meat eaters perceived PBMA as more animal-friendly and more environmentally friendly than meat, but as less tasty and less healthy than meat. Additionally, the PBMA was evaluated by meat eaters as more artificial than meat, and more disgusting than meat but less harmful, and equally frightening as meat.

Reducetarians perceived lab-grown meat as less tasty and less healthy than meat, but as more animal-friendly and more environmentally friendly than meat. Additionally, the lab-grown meat was evaluated by reducetarians as less harmful than meat, but more frightening and more artificial than meat. It was also evaluated as equally disgusting as meat (see Figure 3 and Table 3).

Meat eaters perceived lab-grown meat as less tasty and less healthy than meat, but more environmentally friendly than meat and more animal-friendly than meat. Additionally, the lab-grown meat was evaluated by meat eaters as more disgusting, more frightening, more artificial and more harmful than meat (see Figure 3 and Table 3).

Reducetarians perceived insect-based food as less tasty and less healthy than meat, but as more animal-friendly and more environmentally friendly than meat. Additionally, the insect-based food was evaluated by reducetarians as more disgusting, more frightening, more artificial, but less harmful than meat. It was also evaluated as equally incompatible with nature as meat (see Figure 4 and Table 4).

Meat eaters perceived insect-based food as less tasty, less healthy and less environmentally friendly than meat. Additionally, the insect-based food was evaluated by meat eaters as more disgusting, more frightening, more artificial and more harmful than meat. It was also evaluated as equally animal-friendly as meat (see Figure 4 and Table 4).

Discussion

The study addressed a currently important issue – the level of acceptance of various meat substitutes and their perception in relation to meat. The results showed that consumers have by far the most positive attitude toward plant-based substitutes and the least positive toward products containing insects (or insect protein). However, the perception of these products varied depending on the dimensions. Plant-based meat substitutes are perceived as the healthiest and at the same time healthier than meat. Nevertheless, both plant-based alternatives and lab-grown meat are perceived as slightly more animal- and environmentally friendly, which shows that communication about the negative impact of traditional meat production is most likely being accepted by consumers. However, the perception of their taste as significantly worse than meat remains a major barrier to all three types of substitutes. A specific barrier to insect-based substitutes is the feeling of disgust or even fear frightening.

The perception of all three types of substitutes also differed depending on the respondents' diet. People who do not eat meat or limit their meat consumption perceive all three types of substitutes much more positively (or less negatively) than people who eat meat without restrictions. It is likely that people who limit their meat consumption have more experience with substitutes and see that they are often just as tasty as meat, which reduces one of the most important barriers, namely the belief that these products are less tasty than meat. In this situation, even if people have not tried certain types of substitutes (such as those based on insects or lab-grown meat, which is almost certain), they may transfer their positive or negative experiences with PBMA to non-plant-based substitutes.

Another factor that should be acknowledged when interpreting our findings concerns the terminology used to describe the products in the survey. In the questionnaire, we referred to the alternatives using the terms *mięso roślinne* (plant-based meat), *mięso z laboratorium* (lab-grown meat), and *jedzenie oparte na owadach* (insect-based food). Although these expressions are understandable to consumers, they represent only one possible set of labels. For instance, lab-grown meat can also be described as *mięso komórkowe* (cell-based meat), *hodowane mięso* (cultivated meat), or *sztuczne mięso* (artificial meat), each carrying different emotional and cognitive associations. Prior research (see e.g. Bryant & Barnett, 2019) suggests that such labels can substantially shape consumer responses, as some terms highlight naturalness (e.g., "cell-based" or "cultivated"), whereas others – such as "lab-grown" or "artificial" – may evoke stronger perceptions of artificiality or technological intrusion. Given this, it is possible that the terminology we used, particularly "lab-grown meat", could have contributed to more negative assessments of this alternative by emphasizing its perceived artificial or unnatural character. Similarly, describing insect products as "insect-based food" may foreground the insect component more than alternative labels such as "insect protein". Because nomenclature itself can elicit emotional, cognitive, and sensory expectations, it likely interacted with participants' evaluations – especially

in dimensions related to perceived artificiality, fear, or disgust. Future research should therefore examine how different linguistic framings influence consumer acceptance of emerging protein sources, particularly in cultural contexts where familiarity with these products remains low. Testing multiple labels within the same study would allow for a more nuanced understanding of how language shapes perceptions and could help identify terms that facilitate more accurate or less biased consumer evaluations.

In the context of the study, it is worth considering to what extent the current perception of the substitutes surveyed may influence the market success of these products. In the case of plant-based alternatives, most consumers accept these products and, even if they do not include them in their diet, they do not have any strong negative feelings about them. However, the most barriers are found in the case of insect-based foods, where very emotional reactions such as disgust or even fear dominate. In this case, campaigns encouraging people to eat such products will be much more difficult and will probably require more long-term efforts.

The study has clear practical implications. As modern Western societies gradually shift towards reducing meat consumption, and the number of reducetarians is expected to increase in the coming years, an important question arises: what products can replace meat as a source of protein while also being accepted by consumers? The findings indicate that plant-based substitutes have the greatest potential. In contrast, insect protein faces the strongest consumer resistance, even though it is already legally permitted in Europe, including Poland. In this case, however, a strong cultural barrier remains. Lab-grown meat, on the other hand, does not evoke such strong negative reactions as insect-based substitutes, but its high price continues to pose a major obstacle. The second important practical implication of the study concerns identifying the key consumers of meat alternatives. The findings show that, regardless of the type of alternative, these products are much better received by so-called reducetarians than by people who consume meat without restriction. This result is particularly significant because it is this group of consumers – rather than those who completely give up meat – that is expected to grow in the coming years (Hezaveh et al, 2024).

The study had some limitations. First, it focused solely on the perception of the tested products. Although respondents indicated on a scale how tasty they considered them to be, they did not actually evaluate their taste. It would therefore be interesting to examine in a follow-up study to what extent taste is indeed a significant factor in the acceptance of such substitutes. However, previous research has shown that simply informing participants that a product contains insect ingredients – even when it did not – reduced its perceived tastiness (Modlińska et al., 2020). Another limitation is that the study was conducted only in Poland. Future research could examine whether similar results would be obtained in countries where, for instance, insects are not as strongly culturally stigmatized, or in contexts where sustainable consumption is more developed among consumers, potentially making them more open to experimenting with such substitutes.

Notes/Przypisy

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[2] https://label-bank.com/blog/foodlabel/202311plant-based

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