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Editorial: Alternative protein source for a sustainable and healthy nutrition

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Editorial on the Research Topic
Alternative protein source for a sustainable and healthy nutrition

Introduction

The global food supply faces significant challenges in providing everyone with an adequate amount of nutritional ingredients without causing substantial harm to the planet. In this context, alternative proteins are increasingly discussed due to the costs and benefits associated with their production and consumption.

The exact definition of alternative proteins is itself a subject of debate. Grossmann and Weiss (2021) define them as "proteins produced from sources that have low environmental impact to replace established protein sources. They can also be obtained from animal husbandry with good animal welfare." Hence, this definition encompasses both animal and non-animal sources, spanning from insects and cultured meat to plant-based alternatives, which can even include some invasive plants. For instance, the study by Iyer et al. assessed the potential of Gorse, Vetch, Broom, Fireweed, Bracken, and Buddleia as alternative protein sources.

Economically, alternative proteins are gaining traction, with projections indicating an annual growth rate exceeding 36% (Joseph et al., 2020). Yet, several aspects need to be discussed to determine whether alternative proteins are a substantial tool for improving consumer welfare and limiting the use of the planet's resources. These include their actual environmental sustainability, their influence on improving animal welfare, providing consumers with more nutritional foods, and the impact on diets. Other aspects complete the picture, such as consumer acceptance, technology availability, and accessibility. These aspects will be briefly discussed below.

Environmental sustainability

Alternative proteins are increasingly viewed as a more sustainable option compared to traditional animal husbandry proteins. While there is compelling evidence indicating that plant-based foods, such as legumes, boast lower environmental footprints (see Ferreira et al.), the sustainability of certain alternative proteins, particularly those derived from animals, remains a Research Topic of debate. As well-pointed out by Santo et al., novel products like cultured meat lack comprehensive data to assess their environmental impact

accurately, primarily due to limited data availability at scale. Nevertheless, early findings from a life cycle assessment (LCA) using real company data suggest that cultured meat may offer greater sustainability compared to conventional chicken and beef production methods (Onwezen et al., 2021).

In the case of insect-based proteins, research indicates that scale insect production may have a comparable environmental impact to chicken farming (Green et al., 2022). However, further research is needed to fully elucidate the environmental implications of alternative animal proteins and optimize their production processes for maximal sustainability.

In this context, is of primary importance to focus on sustainability calculation methods. Although LCA provides several evidences about the impact that a process can have on Earth's resources, it poses some limits that can be better challenged by new calculation methods, as shown in Francis et al., where the environmental impact has been calculated with new weights that take into account the total or specific production impacts at the country level.

Animal welfare

The adoption of alternative proteins is expected to mitigate the negative impact of traditional animal husbandry on animal welfare. However, the discourse surrounding alternative proteins and animal welfare warrants nuanced analysis. For instance, the welfare of insects seems to be currently perceived as less significant than that of vertebrates, and there is ongoing debate regarding the consciousness and ability to experience pain in insects (Delvendahl et al., 2022). It could be argued that in the present landscape, the emphasis of animal alternative proteins is more on reducing animal suffering rather than eliminating it entirely. This is exemplified in cultured meat production, where animals are not slaughtered but still undergo biopsy procedures. Cultured meat has drawn the bulk of the research focus in cellular agriculture, while precision fermentation—a technology that allows for the creation of individual components of animal products, such as milk or egg proteins—remains relatively underexplored. The study by Zollman Thomas et al. illustrates the potential of precision fermentation-made eggs in Germany, Singapore, and the USA in terms of consumer acceptance. Their findings suggest that such products are likely to find a willing market, especially amongst vegetarians and vegans.

Consumers' health

The adoption of alternative proteins is expected to yield primarily beneficial outcomes for consumers in terms of health and nutritional intake. These proteins typically contribute to a higher fiber content and lower cholesterol levels, thereby aiding in the prevention of non-communicable diseases. For instance, in the study by Sistia et al., plant-based diets have been linked to a reduced risk of obesity among women of reproductive age. However, it is important to note that alternative protein diets may contain lower levels of protein, zinc, and vitamin B12 compared to traditional diets (Green et al., 2022). Additionally, there is a growing concern regarding the higher incidence of allergies associated with plant-based foods, which could adversely affect the quality of life and increase healthcare usage among susceptible individuals (Kopko et al., 2022). Therefore, it is of primary importance of improving the quality of proteins, as shown in the discussion provided by the article of Pikosky et al..

Given these considerations, the shift in diet toward alternative proteins may not be optimal for all consumer categories, especially in the context of personalized nutrition. A transition phase, exemplified by a flexitarian diet, presents an opportunity to assess the feasibility of transitioning to a different protein source from both physiological and psychological perspectives (Banach et al., 2022).

New technologies

A critical point concerning alternative proteins is their substantial energy use. This characteristic hampers their environmental sustainability and limits the acquisition of economies of scale. It is expected that improvements in renewable energy production will foster the production and innovation of alternative protein production and related technology (Green et al., 2022). This Research Topic can be even more challenging for rural or marginalized communities that struggle to access basic foods like lentils or tofu (Green et al., 2022).

Alternative proteins can broaden their appeal to consumers through research that expands their choice sets. This can be done by introducing new protein sources, as explored by Craine et al. with a new legume from sainfoins, or by adding further benefits to known products, as demonstrated by Mudgil et al. in their work on improving probiotics.

Economic sustainability

The affordability of alternative proteins represents a major challenge. A healthy diet has already been proven to be more expensive than others with less healthy food (Hirvonen et al., 2020), which may hinder the adoption of alternative proteins even with more mature technology and economies of scale (Green et al., 2022). People with less education may also find it harder to be fully informed about alternative options to meat and may be reluctant to adopt them without proper and accessible information. Additionally, in wealthier populations, there may be more challenges due to the luxury halo characterizing meat consumption (Green et al., 2022).

Acceptance

Current evidence suggests that the adoption of alternative proteins varies among different populations. The study by Huang and Uehara indicates a growing willingness among consumers in China and Japan to embrace alternative proteins in the near future, while other evidence suggests that only a minority of consumers in the US express a readiness to try these foods (Joseph et al., 2020). In Europe, acceptance appears higher due to the widespread

availability of meat substitutes in mainstream retailers and food services (Mylan et al., 2023), although their capacity to fully replace meat and its derivatives remains uncertain.

In this context, the influence of flexitarian diets is worth considering. Although lacking a precise definition, flexitarian diets allow for occasional consumption of meat and animal-based foods within a predominantly plant-based framework (Green et al., 2022). They are gaining importance due to increasing awareness of environmental, nutritional, and animal welfare concerns, particularly among those finding it challenging to adhere to strict vegan or vegetarian diets long-term.

Healthiness, taste, and environmental attributes are identified as primary drivers for alternative protein consumption. Additionally, individual traits such as neophilia-neophobia—a propensity to embrace or reject novel foods—and personal dietary preferences influence acceptance, with vegans and vegetarians being more receptive to plant-based options (Pliner and Hobden, 1992). However, insect-based foods face unique challenges related to consumer perceptions of appropriateness and food safety (Onwezen et al., 2021).

On the product side, the acceptance of alternative proteins may be enhanced by their resemblance to meat derivatives, possibly due to familiarity. Texture plays a crucial role, with consumers generally preferring a smooth, tender, meat-like texture, particularly younger consumers (Aaslyng and Højer, 2021). Color and appearance, resembling meat, are also significant factors (Joseph et al., 2020). Improving the textural properties of meat analogs, for example using mung bean and pumpkin seed proteins, could enhance consumer acceptance of meat alternatives, as suggested by Baig et al. Therefore, efforts to make alternative proteins more akin to traditional meat products could facilitate their adoption among diverse consumer groups.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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