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Alternative Proteins: A solution or an obstacle to sustainable diets?



It has become quite clear to anyone paying attention that the ways in which we produce food and make it available for human consumption are increasingly problematic.

The contribution of the food system to the global climate crisis – accounting for around 30 percent of greenhouse gas emissions – and its role in habitat destruction, biodiversity loss, the disturbance of global nutrient cycles (N and P) and in the depletion of freshwater resources is widely acknowledged. Yet the food system is also failing to feed people adequately, with numbers of chronically hungry and malnourished people remaining stubbornly high while those suffering from diet-related diseases continue to rise^[1].

Although the food system is a highly complex arrangement of many dynamic elements such that attributing failure to any one single cause is a hazardous exercise, there is now a strong basis of scientific evidence that demonstrates the production and consumption of animal protein carries particular responsibility. During the past half century or so meat and dairy consumption has grown at a rapid rate with the value of the global meat sector estimated to have risen from \$65 billion in 1961 to \$897 billion in 2021 and is projected to increase to \$1354 billion by 2027^[2]. Such growth reflects an enormous transformation in production practices whereby livestock farming has been largely decoupled from local feed resources. Instead of flocks of egg-laying and broiler poultry or herds of pigs or cattle foraging for their food from the ground, industrial feeding operations deliver high protein rations within tightly confined spaces to animals bred for their efficiency of feed conversion. Factory farming, as it is called, has now become the standard operating procedure for producing animal proteins most 'efficiently' (ie with least financial cost and with greatest profit margin) although the externalities of such systems are becoming impossible to ignore. Globally, it is estimated that almost 80 percent of all agricultural land is used to

support the production of animal protein (combining grazing and cropland used for animal feeds). At a more regional scale intensive livestock production is responsible for nitrate loading of drainage catchments arising from the spreading of manure as a means of disposal as well as fugitive losses from slurry tanks and wastewater from cleaning operations. Air pollution, too, is a major issue as methane (from ruminant animals in particular) is a significant greenhouse gas, while noxious smells and air-borne zoonotic pathogens can affect nearby communities.

While these are the consequences from intensive animal feeding operations the true economic costs of the meat and dairy system do not reflect them. Indeed, consumers in rich countries have benefitted from relatively cheap animal products that are also subsidised given generous government policies towards the largest meat and dairy corporations^[3]. It is in this context that efforts to change consumption practices are proving so difficult despite the epidemiological evidence demonstrating that diets comprising lower levels of red and processed meat are beneficial to health. In this respect meat consumption has unfortunately become a defensive pillar of ‘consumer sovereignty’, a self-proclaimed right to maintain existing dietary practices irrespective of the evidence stacking up against it. Naturally, there is a broad coalition of vested interests ranging from Big Meat corporations, through livestock farmers and producers to consumers, determined to protect ‘business as usual’.

However, although public policy as yet appears to have made little impact on dietary choices regarding meat, growing numbers of people – though still a small minority – have helped to establish a new narrative around plant-based eating. Responding to a concern for animal welfare as well as the growing environmental evidence of livestock impacts, the last decade or so has witnessed the rise of a new and diverse technology sector loosely framed by the umbrella terms ‘novel foods’ or ‘alternative proteins’ (AP). Drawing on advanced scientific techniques (including genetic engineering, precision fermentation, AI) new food products are gradually emerging offering an alternative to established meat, fish and dairy staples. Utilising ‘plant’-based materials (covering micro-organisms, fungi and

algae here), insects or cell-tissue culture this sector promises to deliver products that will largely replicate the experience of eating meat or fish but without the environmental and ethical burdens involved. Such has been the promise of this vision and its technologies that hundreds of billions of dollars of venture capital have been invested into many new start-up companies established in Silicon Valley and elsewhere since 2013.

One aspect of these recent developments has been the claims made by industry proponents that have arguably stretched credibility and strayed into exaggeration and hubris. In the language of Silicon Valley (characterised by its mission statement ‘to move quickly and break things’): “Disrupting the legacy food system is a global imperative if we are to have a thriving society... we are on the precipice of seismic shifts in how our food is produced and delivered.”^[4]. For those of us with long-standing concerns in sustainable diets and human well-being, the promise of delivering ‘magic bullet’ solutions – together with a promiscuous deployment of such concepts as ‘sustainability’ – triggers a precautionary response. This is because we are alert to the consequences of a solutionist narrative that easily distracts policy (and funding) from engaging in the kinds of structural changes that are truly needed to affect a necessary food system transformation, and that can also mislead the population at large, including those potentially willing to pursue a whole plant-based diet.

The appearance of plant-based meat analogues in fast-food restaurants and on supermarket shelves offers eaters a route to reducing their meat consumption. This is surely to be welcomed. But in my view, we need far more critical attention to be given to these new products and especially the narrative of ‘solutionism’ that surrounds them. Although significant financial investment has enabled scientific progress to be made with cellular, in-vitro cultivation of animal stem cells using tissue engineering techniques, this sector currently lags the development of plant-based products, many of which are now commercially established (if at market growth rates below expectation given their higher price). Insects, meanwhile, appear to have limited appeal other than as a protein fortification ingredient in flour and baked goods. Finally, precision fermentation of protein-rich bacteria in bioreactors is a fourth sector that its

proponents believe holds enormous promise and which, in the words of journalist George Monbiot is “the most important environmental technology ever developed. It might be all that now stands between us and Earth systems collapse”^[5].

Common to these different technological processes is, of course, the pursuit of protein production at scale but which requires convincing narratives to help secure regulatory approval and, crucially, customer engagement. Consequently, we have seen a range of tropes being utilised to make the case for these novel meat- and dairy-free products including: neo-Malthusianism (“how will we feed a world of 10 billion people without them?”); addressing the climate crisis (reducing methane from ruminants); land-saving (no longer needed for grazing or cultivation of feed crops, land can be set aside for rewilding and biodiversity recovery); eliminating animal suffering and death; even improving dietary health. Such claims have not always been convincingly verified, of course, although their discursive power is evident. Why, then, should we wish to call into question the potentially beneficial contributions that alternative proteins might offer?

First, a consequence of media interest in the novel foods sector is that it skews to the celebratory and thus overshadows a broader debate on what these developments might mean for food and agriculture more generally. Despite the early running made by Silicon Valley start-ups and their philanthropist and venture capital associates, it is now clear that the dominant players in this sector are the Big Food incumbents. Multinational livestock, meat and dairy corporations have now taken a leading role through acquisition and investment strategies enabling them to proclaim themselves protein companies. This (re-)positioning around a macro-nutrient regarded as indispensable to human health serves to obfuscate those companies’ continued activities in meat while spreading risk in the event of regulation or climate-driven destocking rules; enables the co-existence of novel foods with business-as-usual livestock operations; and crowds out alternative solutions for just, equitable dietary solutions. In other words, the development of AP may yet lead to greater consolidation in a food system already characterised by excessive concentration^[6].

Secondly, while the argument has been that AP will compete with and displace conventional animal products on the basis of their presumed environmental and ethical superiority, they do not challenge the imperative of consumerism and freedom of choice. Consequently, for many observers the availability of new plant-based products will simply be to provide an additional range of items from which consumers can choose. Rather than offering a pathway toward encouraging exclusively whole plant-based eating, it provides a flexitarian escape route where the occasional dish of AP enables a justification for continuing to eat meat on other days. While behavioural nudges that might slightly reduce volumes of meat consumption are welcome, they are unlikely to enable us to meet our climate targets of 1.5°C or significantly lower rates of dietary ill-health.

Third, it is not yet clear whether the nutritional profiles of AP are as good as their proponents suggest. While they may achieve comparability in terms of protein and other essential nutrients, the use of ingredients to provide flavour, colour, edibility, digestibility and binding agents has raised concerns about levels of sodium and other markers characteristic of ultra-processed foods. Moreover, it is worth reminding ourselves that the majority of these AP products are presented in the form of burgers, nuggets, meatballs, hot dogs and other processed and extruded shapes symptomatic of fast-food eating. Invariably served with potato fries and within a white bread bun, the dish is not a testament to healthy eating. A related issue raises questions about how AP fit within existing culinary traditions and its associated agri-food culture given their tendency to mimic conventional fast-food analogues. What does the increasing prevalence of such products mean for more territorially specific and healthier foodways such as the Mediterranean Diet?

While there are space implications arising from all four kinds of AP, perhaps the most potentially far-reaching is that set out by proponents of precision fermentation. Using microbes as cell factories in order to produce protein-rich microbial biomass capable of providing a wide range of functional ingredients, brewery-style fermentation takes place in bioreactors. It is argued that these need significantly less land than that used by agriculture to produce comparable

quantities of protein; in which case there is no longer any need to support such large numbers of animals or the farms, ranches and feeding operations in which they live. Rewilding such land for the recovery of nature may be ecologically desirable, but what of the livelihoods of farmers and workers involved in this industry? What of the rural economy in these grazing and feed-crop regions? Such questions remind us that formulating ambitious technological solutions ('techno-fixes') such as molecular food fabrication may result in an inadequate framing of the problem from the outset and consequently leads to the exclusion of critical issues and key stakeholders. The development of the AP sector must therefore take seriously the importance of a 'just transition' such that farmers who manage livestock operations – especially in upland and marginal environments with fewer arable options – are brought into consideration.

While there appears to be some enthusiasm for AP amongst animal welfare interests given the promise of reduced animal slaughter and suffering, cultured meat requires a continuous supply of animal stem cells from biopsies as well as the extraction of foetal bovine serum that is used as part of the growth medium. It is such inputs that make cultured meat currently so expensive and a key challenge for the industry is to find ways to reduce input costs and scale up in order to make their products more economically competitive. In the meantime, while plant-based AP hold an advantage given their longer presence in the market and an easier regulatory approval process given their ingredients are 'generally recognised as safe' these products also face challenges. Affordability is key, but there is also labelling (eg the prohibition on plant-based drinks being labelled 'milk'; a requirement to use the prefix 'imitation' before meat); and consumer adoption may well be shaped by the prevailing narratives that make eating such products 'cool' or healthy.

In this respect nutrition science has a very important role to play in facilitating an informed debate around these new foods. Technology will clearly continue to offer innovations in ways of delivering healthy, nutritious, tasty and sustainable food but it cannot be presumed to be the sole source of solutions without taking into account the social, political and economic systems in which it is embedded. Challenging the dominant narratives of technological solutionism in the service

of profit accumulation and corporate control is vital if we are to build a genuinely democratic, equitable and sustainable food system. And nutrition scientists ought to be at the forefront of this debate.

[1] [Sage, C. \(2022\) Introduction. In A Research Agenda for Food Systems](#)

[2] <https://www.statista.com/statistics/502286/global-meat-and-seafood-market-value/>.

[3] [Béné and Lundy 2023 Political economy of protein transition: Battles of power, framings and narratives around a false wicked problem](#)

[4] [Rethink Food Digitizing the food system](#)

[5] [Monbiot \(2022\) Fermenting a revolution](#)

[6] [Clapp, J. \(2022\) The rise of big food and agriculture: corporate influence in the food system](#)

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