Lab-grown meat and other Petri-protein industries

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What is Petri-protein?

We use the term Petri-protein to refer to protein – usually foodstuffs – that have been created through industrial biotechnology, a prime tool of which is the laboratory Petri dish. It is used to refer to all protein sources novel or traditional, not obtained from animals.

Most Petri-proteins on the market at present are designed to be consumed as something resembling meat, fish or eggs. Lab-grown meat is the form of Petri-protein that has attracted most attention (see Box 1). Those promoting investments in this form of protein use the emotionally-resonant but misleading term 'clean meat'. Meanwhile there is also a burgeoning industry involving Petri-proteins that uses genetically modified (GM) organisms as substitutes for the qualities of meat that they have found are valued by current meat consumers. The Impossible Burger, launched in the US in 2016, does not contain any meat-derivatives. However, the product does include an analogue of the 'heme', which is part of haemoglobin – the iron-containing oxygen-transport protein in red blood cells. The heme in Impossible Burgers is manufactured using GM yeast, giving the burger's 'juice' a red colour. Though processes of culturing of GM microbes, like yeast, and animal cells are very different, they are both part of the Petri-protein industry (also called cellular or cell-based agriculture). The multi-billion dollar investments being made in them by a cartel of protein mega-corporations, threaten people whose current livelihood is connected with the rearing, processing or selling the products of livestock.

Box 1: Distinguishing the two types of Petri-proteins

Investors in Petri-protein corporations are attempting to grow dairy and meat-like substances in industrial conditions, controlled by artificial intelligence and teams of scientists, using one of two techniques:

A. Lab-grown meat: This is meat-like substances that are grown from animal stem cells. Stem cells are harvested from animals and used to grow steaks in a lab environment without the further involvement of an animal. What is mentioned less often is that this kind of production so far involves the use of substances like bovine fetal serum, hormones, amino acids, food additives (and, we suspect, antibiotics) to achieve a meat-like outcome.

B. Meat mimics: These are Petri-proteins that are genetically modified organisms from non-animal sources, such as yeasts, bacteria or algae. Single-cell organisms are genetically modified to produce compounds that mimic certain qualities of meat, dairy or eggs such as taste, color or protein content through a closed industrial fermentation process.

Why are companies investing in Petri-proteins?

According to conventional wisdom in the global food industry, people choose to increase the amount of animal protein that they buy as their wealth increases. Given the growing middle-class population in many parts of the world, meat consumption is set to rise. Whichever corporation can most efficiently industrialise the production of palatable animal-like protein, stands to make a windfall. An early breakthrough in meat-free industrially-produced protein was the microbe-derived protein food additive, Quorn, invented by the UK chemical giant ICI in the 1980s. It now earns its parent company $260 million (USD) a year across the world. Initially relying on egg albumin as its starting ingredient, Quorn's parent company launched a completely vegan version in 2018, which has helped it break into the US and Australian markets[i].

Quorn's shift to vegan products is part of a trend that sees researchers developing products that can be produced without any involvement of animals. If a range of laboratory processes could be developed that could yield other mimic products – passing off as meat, fish and eggs through non-animal organisms like yeasts and fungi (see Box 1B), all that would be needed for unlimited supply of such products would be a source of carbon (such as sugar or methane), water and some other micronutrients.

The first GM player in the rush for Petri-proteins is the Impossible Burger. Launched in US restaurants in 2016 it has recently been embraced by Burger King and a range of other US restaurant chains. Impossible Foods is now developing plant-based products that emulate chicken, pork, fish, and dairy.

Many of the corporations attempting to capture the alt-protein market justify their investments with an appeal to a vegan ethical standpoint augmented by climate and sustainability claims. They imply that they are supporting campaigners who believe that animals should never be involved in protein production. Their ultimate aim, claim these self-styled ethical-entrepreneurs, is to replace the 'cruel' and 'dirty' processes involved in all forms of conventional livestock and poultry farming with 'clean' forms of production.

One example is Quorn's statement on their promotional video:

> "…we don't start where everybody else does when it comes to protein production. Rather than using livestock, we start by taking a natural nutritious fungus from the Earth, for the benefit of the Earth. We then ferment it, using the same age-old technique that makes other food you like [picture of yoghurt, beer and bread]. The result is mycoprotein, a high-quality protein source that is high in fibre, but low in saturated fat. And because producing mycoprotein uses 90% less land and water than producing some animal protein sources, it is a great example of a more sustainable and nutritious protein source for a growing global population".[ii]

Their "90% less land and water" claim cites its source as the Carbon Trust, a big-business lobby organisation. The chair and almost all the board of the Carbon Trust have direct financial links to the global oil and gas industry[iii]. These links point to what may actually lie behind the interest from corporations in the global alt-protein market. It is not concern for the environment, but rather a bid to fully automate, and thus take control of a whole section of the global food chain. This is despite the fact that this could disfavour, or even in some scenarios eliminate, the livestock and poultry

sectors from countries around the world. As part of the fossil fuel industry's attempt to diversify its profit stream, gaining monopoly, or near-monopoly control of this new industrial food production chain could potentially open up a whole new sector.

Mega-meat corps driving alt-protein

While Tyson and other mega meat corporations are conducting their own research on how to maintain control of the global market for protein, those who have launched their Petri-protein products use rhetoric claiming that they are aiming to break the grip of these meat corporations. We have identified over 25 companies, largely start-ups. Almost all are based in the US, Europe, Israel or Japan. Several of the largest companies either have direct links to billionaires who have made their fortunes in Silicon Valley or indirectly via the Good Food Institute, which itself is funded by a handful of software billionaires. An example is Impossible Foods, the company whose Impossible Burger has been developed with a total investment of $372 million USD from sources such as Google Ventures, Bill Gates, Hong Kong billionaire Li Ka-shing, and the Swiss-based investment bank UBS. Funded by those with a Zuckerberg strategy of creative destruction, they appear to be applying his philosophy of "move fast and break things" to the meat industry.

We estimate the total worth of the start-up companies working on all alt-protein products worldwide to be in the region of $1 billion USD, with around three quarters of that amount being invested in food proteins. Other areas of investment include fragrances, silk and ivory substitutes.

However, a closer look reveals that, rather than breaking up meat monopolies, the sector is instead becoming part of a protein diversification strategy for 'big protein'. Major investors in Petri-proteins include Tyson, Hormel and Cargill and the likely preferred end point for the small ecosystem of Petri-protein start-ups is to be gobbled up by the protein cartels.

Threats to livelihoods

According to the FAO, livestock production currently employs at least 1.3 billion people worldwide[iv]. About 600 million of the world's poorest households keep livestock as an essential source of income. The long Green Revolution of the last half century concentrated power in the hands of those who owned the most land and those who controlled the market in artificial inputs, such as chemical fertilisers and pesticides. In short, it made the wealthy even more rich, while usually doing little to redistribute profits gained from short-term gains in yield to the poor. A global shift to alt-proteins would transfer power away from those who keep, process or trade in livestock and towards people, especially large land-owners, who can produce the raw ingredients for industrial alt-protein manufacturing facilities, most likely sugar.

If it becomes possible to reduce the cost of producing alt-protein, this will eventually feed through into a lower market value for real meat, dashing the hopes of those who expect the technology to eliminate meat-eating. The result may not be the straight substitution of Petri-protein for meat. They may instead merely act as meat extender proteins, acting as high protein bulking agents, other forms of which are already in widespread use in the meat industry. Dairy and egg companies may also see opportunities with Petri-proteins to adulterate their animal products to both extend their life and lower overall costs.

Future scenarios

The current growth in the alt-protein market is driven by an investment bubble and the manufactured demand among the middle class, particularly those who claim ethical concern about food production. This is taking place in the US, UK and some of the world's other richer nations of European heritage, such as Australia.

Some companies, such as Mosa Meats, are investing heavily in lab-grown meat, which involves growing stem cells taken from a live animal in the laboratory. It is currently only possible using bovine foetal serum and thus is still prohibitively expensive.

The example of Quorn suggests that, if the cost of production can be driven down, lab-grown meat could rapidly gain market share. Alongside the technical challenges of lab-grown meat, are the regulatory hurdles it might face. Because the Impossible Burger contained a genetically modified microbe, it was only able to go on sale in the US by using a loophole in food regulation. It has not been sold legally in any other country apart from Hong Kong.

At ETC, we observe the complete lack of life-cycle assessments of environmental sustainability of all alt-proteins. Yeast could only be engineered to generate protein by using intensive monocultures of cells that themselves would be fed by high-input monocultures of sugar and other food sources. We suspect that agroecological approaches, based on low-input rearing of livestock, which then return nutrients to the soil for crop growth, is likely to have a far more beneficial outcome for people and the environment that any approach to industrialised alt-protein that has been proposed.

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[i] See: https://www.independent.co.uk/news/business/news/quorn-vegan-food-research-development-laboratory-vegetarian-sales-a8459666.html

[ii] Taken from film on Quorn's youtube channel: https://www.youtube.com/watch?v=3wlprJOfNDA

[iii] See: https://www.carbontrust.com/about-us/our-board/

[iv] See: http://www.fao.org/news/story/en/item/1157729/icode/