



Towards sustainable meat

Cultured fats are a new kid on the block which can mimic the richness and juiciness provided by animal fats in meat. Because they are derived from animal cells, they do not have the damaging environmental impact of animal farming *David Brandes*

Global meat consumption totalled 341M tonnes last year, according to the Food and Agriculture Organization (FAO) of the United Nations. On average, this amounted to 45.5kg of meat consumption per capita or a staggering 124kg/year or 350g/day in the USA.

Animal farming produces more CO₂ emissions than the entire transportation industry combined, with 7.1 gigatonnes/year of carbon dioxide equivalent (CO₂-eq) or 14.5% of all anthropogenic CO₂ emissions. At the same time, animal farming consumes more fresh water than the entire human population as the production of one kilogramme of beef requires 15,414 litres of water on average.

By 2050, the world population is set to reach 10bn and protein demand will rise by 70%, driven mainly by the growth in

India's and China's middle classes.

Livestock is the world's largest user of land resources, with pasture and arable land dedicated to the production of feed representing almost 80% of total agricultural land. However, only a third of all food calories consumed by humans is produced via these animals.

Given the rising meat demand, combined with limited space and natural resources requirements, animal agriculture farmers will be forced to either create more space efficiency within existing stables, or explore forest and shrubland, often resulting in deforestation.

New alternatives on the rise

Plant-based and cultured meats offer a solution to rising meat demand.

US consulting firm A T Kearney predicts that by 2030, 18% of all meats consumed will be plant-based and 10% cultured meat-based, with these industries needing to supply 73M tonnes and 41M tonnes of meat alternatives respectively (*see Figure 1, following page*).

In order to facilitate such a tremendous shift in the meat eater's dietary habits, alternative meat producers will need to find ways to reach, convert and retain their clientele. Arguably the most crucial step in winning over meat eaters is driven by their taste experience – the meaty, juicy sensation that carnivores crave.

According to a Deloitte report, 86% of consumers quoted "taste" as the largest driver of new food adoption.

However, just 28% of consumers judged the taste of plant-based meats as "good" or "very good".

In addition, 31% of consumers believe plant-based foods taste worse, according to a 2019 Food & Health Survey.

Taste and texture are posing the greatest barriers to meat eaters entering and remaining in the plant-based segment.

The main ingredient providing the taste and texture qualities of a meat product (whether conventional or plant-based) are the fats used.

Animal fats are responsible for the mouth-coating richness of meat and show a higher saturation grade than vegetable fats, which explains the juiciness of livestock meat. Even vegetable fats that are highly saturated, such as coconut oil, still melt at a much lower point than animal fats, so the experienced juiciness in a first bite quickly fades.

Furthermore, animal fats bring about a softness and tenderness which might play a more subconscious role in how we perceive meat.

Cultured fat

Given that producers are currently limited to vegetable fats and oils to provide the taste and texture in plant-based meats, a new product which offers improvements in this area is an exciting development.

Cultured fat is derived from animal cells, rather than by slaughtering livestock.

In the case of avian fat, for example, cells are extracted from a fertilised egg



Photo: Adobe Stock

Players and state of the industry

Companies active in the field of producing fats and oils for the alternative meat space include plant-based fat producers such as Cubiq foods and C16 biosciences, oil farmers and trading houses largely active in the tropical rainforests of Indonesia and Malaysia, and emerging cultured meat producers such as Peace of Meat, focusing on large-scale fat production from both avian and mammalian species.

Most Asian, Israeli and US-based cultured meat companies, including Mission Barns, Shiok Meats and Aleph Farms, have conducted proof-of-concept exhibitions or public meat tastings. In Europe, Peace of Meat displayed its pure cultured fat in early 2019.

Some early and well-funded cultured meat movers include Memphis Meats and Blue Nalu, as well as Mosa Meat. These companies have announced Series A and B rounds to establish semi-commercial pilot factories with production volumes in the range of 100-500kg biomass/month, with the objective to scale up further and reach cost parity with animal-based meats.

Market access of cultured meat products is expected around late 2023 after the products have been successfully regulated by local food safety agencies.

The first regions to regulate cultured meat are likely to be Asia and the Middle East, due to their perceived legislative speed and agility, as well as the reduced influence of meat industry lobbying.

Vegan or genetically modified?

Based on the cultured meat production process, animals may or may not be involved in the value chain and may or may not be considered genetically modified (GM).

The decision whether a product is considered vegan is governed by the absence of animals in the production chain.

Two production factors, the cell culturing medium and the cell line, are

exposed to potential animal involvement. Cell culture media, driving 80-90% of the cost of cultured biomass, traditionally includes animal-derived growth factors. The removal of animal components has been announced by several players like Memphis Meats, Mosa Meats and Peace of Meat.

Secondly, the choice of the starting "cell line" and isolation technique determines the degree and frequency of animal exposure. Some companies rely on extracting biopsies from the living animal which serve to produce around 2,000kg of cultured biomass each. Other companies extract a similar cell line from fresh carcasses.

A non-intrusive way to continuously produce cultured meat without sustained animal exposure is achieved through immortalisation of cells, thus maintaining proliferation. Cell immortalisation through CRISPR technology and RNA editing is common practice in the USA and some Asian markets. However, this might be considered genetic modification in Europe and affect consumer perception.

Avian species allow for the extraction of stem cells from eggs before the embryo has formed. Such a cell line can arguably be considered vegan since an extraction theoretically needs to happen only a single time and will then allow for endless natural proliferation.

The essential question to ask, however, is "what really matters to the consumer?" For the target group of meat eaters craving mouth-coating richness and juiciness, claims like "vegan" or "GMO" might be secondary to product meatiness.

Changing the dietary habits of meat eaters around the world will require massive scale but cultured fats can help facilitate a step in this direction for those concerned with the environmental impact of animal farming.

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before the embryonic stage.

As those cells multiply, they are scaled to large volumes in a controlled environment. Once a critical mass is archived, the cells are programmed to develop into fat cells that are good for consumption. Only a single cell is needed to produce unlimited amounts of cultured fat and the upscaling process does not require animal components.

With cultured fat acting as a taste and texturing ingredient, the two contenders in the race towards protein replacement – plant-based meats and cultured meats – can now be combined to create a food product which can win over meat eaters.

Each element provides unique and differentiating properties. Plant-based proteins have a similar molecular structural composition to meat-based proteins. Cultured fats add the missing taste and texture that meat eaters crave.

Ecologically, the combination makes sense. The feed conversion ratio (FCR – the amount of feed/crops needed to produce a unit of meat) for beef is the worst of the entire food ecosystem, with only one food calorie produced for every 25 calories consumed by the animal.

Cultured meat, on the other hand, "could be produced with up to a 96% reduction in both greenhouse gas emissions and water consumption, compared with conventional meat", according to an Oxford University study.

When applying the novel technology to create hybrid products consisting of plant-based and cultured fat, only 10-25% of cultured fat is needed to generate 100% of meatiness, depending on the product.

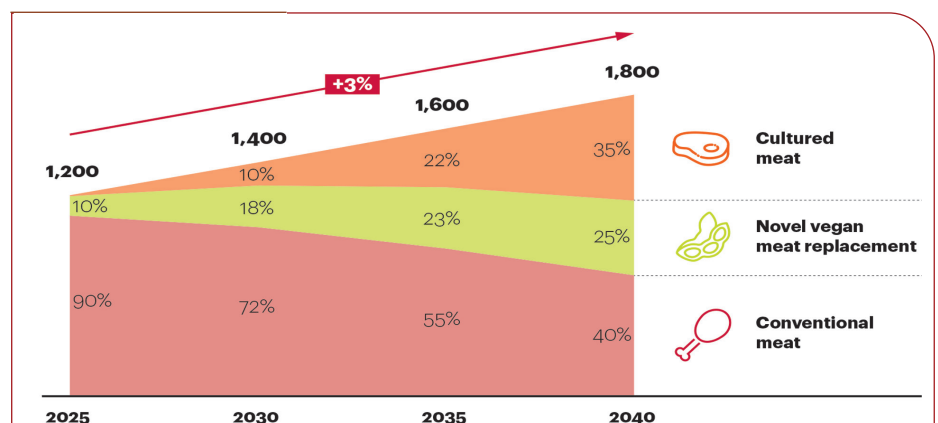


Figure 1: How will cultured meat disrupt the food and agricultural industry? (US\$bn)

Source: A T Kearney, 2019