Life After Meat: The Bioeconomy's Alternative Protein Sources – Part 2

In recent years there has been a substantial increase in the amount of people interested in reducing their meat consumption. The environmental impact of agriculture and farming, in particular meat production, is coming under increasing scrutiny as being responsible for significant carbon emissions. However, there is still an appetite for protein. Beans and legumes for example contain high amounts of protein, but there is significant demand in the market for protein and people like to have choice when it comes to their food. There are a variety of protein sources that are currently available and in development, some with the bioeconomy to thank.

Last year we wrote an article which aimed to give a quick introduction to the industry, and highlight a few of these meat alternatives. In part two, we dig a little deeper and aim to build up a picture of some of the key players, predominantly in the UK.

Protein from Microbes

Perhaps the most well-known process currently in the field of meat alternatives is microbial fermentation – with some products having been commercial for a number of years.

Quorn is a protein derived from fungi. Quorn was launched in 1985 and originates in the UK, with production now in Billingham in the North-East of England. Quorn products are made using Quorn's mycoprotein, a single cell protein, produced from the fermentation of a fungus which is known as *Fusarium venenatum*. In the fermentation reaction, media such as starch is pumped into the reactor as food for the fungi, and the resulting mycoprotein is harvested after five weeks. Additional processing steps are required post-fermentation to make the protein suitable for consumption. Heat treatment removes excess RNA, and the resulting biomass is often bound together with a protein like egg white or gluten for the appropriate 'meat-like' texture.

In Scotland, 3F BIO are also developing technology to produce a mycoprotein, which they've branded as 'Abunda®'. The novel aspect of the 3F BIO technology is that it combines two, usually stand-alone processes, into one integrated process in order to minimise waste and produce their mycoprotein more sustainably. The fermentation process of mycoprotein is integrated with a bioethanol refinery, meaning the initial grain is produced into food, fuel and animal feed, with no waste. The company's vision is to produce one million tonnes cumulatively by 2030. Although not yet commercial, they are capable of large scale production of fungal protein, and have secured funding to explore Abunda's scale-up. In addition, 3F BIO, along with a consortium of nine other partners, received funding in 2019 from the Bio Based Industries Joint Undertaking and launched the project Plenitude, which aims to build a first-of-its-kind, large-scale, integrated biorefinery facility to produce proteins for food from low-cost sustainable feedstocks.

Deep Branch is a biotechnology start up originating from Nottingham, now with activities in the UK and the Netherlands. They produce protein for animal feed, but rather than using sugar as the carbon source they are instead using carbon dioxide emissions. Using carbon dioxide and hydrogen as carbon and energy sources for a gas fermentation process, a single cell protein is produced which is optimised for animal feed, which they have branded as 'Proton™'. Recently, they announced they are building a production facility in the Netherlands, but closer to home, are working with Drax and AB Agri among others to explore the feasibility of using carbon capture to make sustainable animal

proteins. REACT-FIRST, financed by Innovate UK, is a carbon recycling project in the UK which launched in Summer 2020. Led by Deep Branch, the consortium will work to scale up the production of feed from industrial emissions and microbial process.

Meatless Meat

In the last few years, there has been a big increase in interest in cultured meat, with a variety of start-ups in the UK and the rest of the world looking to get into the sector, although it may yet be a few years until a piece of cultured meat makes it to the table. The first cultured meat was unveiled in 2013 and cost $280,000 to make, which left some way to go until commercial production. The expense as well as food safety regulations is a barrier to production, however, the sector has come a long way and multiple companies are racing to get a product ready for the market.

British start-up Higher Steaks is focused on creating cultured pork, with products like pork belly and bacon produced last Summer. They have also moved their base to Cambridge where a biotechnology cluster has emerged, and from there are hoping to finalise funding for a pilot plant.

Globally, there is significant interest in this space, particularly in the US where Just Meat, Memphis Meat and Finless Food all have products in development. It is now four years ago that Memphis Meats first made meatballs, and are now working on their pilot plant to up the scale. In Europe, there are several companies working on developing cultured meat, particularly in the Netherlands and Israel. Mosa Meat and Meatable, both of whom are based in the Netherlands, are working to scale up production and scale down costs and Meatable is aiming to have their product in stores by 2025. There are multiple Israeli start-ups working towards a commercial product like Future Meat Technologies and SuperMeat. Future Meat Technologies have shortened the production time of their patent-pending technology to two weeks and by 2021 are planning on selling hybrid products that use lab-grown fat and plant protein. Other notable companies include Shiok Meat in Sinapore and India based ClearMeat. Globally, there is a lot of innovation in this space with high market growth predicted. There is an expectation, that once commercially competitive this production method will supply a large proportion of the protein we eat.

Protein from Plants

Plants are a major source of protein, and as well as some of these new developments for protein, maximising the outputs and increasing the efficiency of some of our current crops will also go some way towards minimising our environmental footprint.

Horizon Proteins are a Scottish company who transform coproducts from the whiskey distillery industry into proteins for animal feed, particularly for Scottish salmon farms. The company has developed a patented technology for the recovery of proteins and other macromolecules present in the by-products of the distillery process. They have already undergone three large scale industrial trials so perhaps some of Scotland's annual three billion litres of pot ale will soon be transformed – circular economy style.

Insects

Insects may not overcome all the ethical concerns that meat alternatives hope to alleviate, however they are a great source of protein with much improved environmental credentials. Growing them requires less energy input and also provides a means to recycle food waste.

Entocycle, based in the UK, breeds insects for animal feed and pet food. They feed the insects with local food waste, including surplus fruit, vegetables, brewers grains and spent coffee. In 2020 they secured government funding to build a large scale facility just outside of London. Also based in the

UK are Eat Grub, growing insects for human consumption, recommended as a crunchy garnish for meals or as a small snack. Ynsect, based in France, produces insect protein for aquaculture and petfood and is already building its second production unit.

The innovations in the alternative proteins sector are exciting, and will undoubtably continue to develop as more scrutiny is applied to agricultural practises. Unsurprisingly, cost of production is more often than not a barrier to getting some of these products to market. However, there is also a legal issue to contend with, novel foods are under strict regulation and require approval before they are able to be placed on the market. Nonetheless, it will be interesting to see how the market for alternative proteins continues to unfold in the coming years.