



# GRUB'S UP...

## but who's dining?

**New European Union PAP Legislation will give novel proteins the green light. This article by James Cooper, who has recently eaten food-grade insect snacks himself, examines where the appetite for novel proteins and insect meal is coming from and how they will impact feed sustainability and food security over coming decades**

by James Cooper, Milling and Grain Correspondent, UK

**I**t ought to be obvious to anyone with an appetite for the truth that the way we currently produce and consume food is unsustainable – and that structural change must happen if we do not want to end up with half the world remaining obese while the other half is malnourished, and our environment exhausted in an effort to provide more.

Our current situation sees animal feed competing head on with human food and fuel production over land, water and fertiliser resources.

An increasing scarcity of resources, coupled with the increasing demand for animal proteins worldwide are two key indicators that reflect the urgency to further optimise food-producing sectors.

The Food and Agriculture Organisation of the United Nations (FAO) estimates that the world needs to increase its food production by 70 percent to meet demand, and to do so sustainably.

As a result, many countries are positioning themselves to source resources locally that won't further wreak havoc on the planet, and within this space novel proteins offer great promise. But can they deliver what the feed industry needs - in time and on the scale required?

And perhaps more to the point, with rising prices and burgeoning appetite for soy not just from China but across Europe and the developing world, how can the countries who need feed proteins the most afford them?

New sources of high-protein feed materials such as insects and algae are entering the market and can add value to low protein grains and other low-value by-products. These novel proteins represent real alternatives to imported soy and fishmeal and is a

sector developing rapidly across the European Union.

However, EU rules regarding the feeding of animals to other animals are tightly controlled, some might say too tightly. Mercifully, following the BSE crisis, the days of indiscriminate feeding of mammalian meals to farm animals has long gone. But we are facing new challenges in the search for sustainable and efficient proteins to support the key, infant growth phase in farmed animals, including fish, but especially in chickens and pigs.

It is the responsible sourcing of the high protein component in feed that could make the biggest difference to sustainability. Other fibre, energy and additional nutrition can then be provided locally. So, from a sustainability point of view, the number one pressure facing the feed industry is the responsible sourcing of soy and second, the feed industry is looking at what the alternatives might be to soy.

Most of us know what sustainability means, but improved efficiency is key.

### **The feed producers' perspective**

Nick Major leads on sustainability at ForFarmers, a Dutch PLC producing around 10 million tonnes of animal feed annually for The Netherlands, Germany, Belgium, Poland and the UK. He's also a board member of FEFAC which is the European Feed Manufacturers Federation and AIC (the Agricultural Industries Confederation), which is the UK's agri-supply body. He knows quite a lot about feed and according to Mr Major, the alternatives to soy fall into three groups:

"Firstly, consider feeding systems, which is just how you view targets," he says. "The key here is understanding the specific

requirements of the animal, so that less crude protein is required across the growth of the animal and therefore less high protein material like soy is needed.”

Mr Major describes an ongoing trend to use more European proteins meals like sunflower and rapeseed. As the industry learns more about feeding characteristics, the inclusion levels have gone up and the anti-nutritional factors are being bred out, particularly in rapeseed.

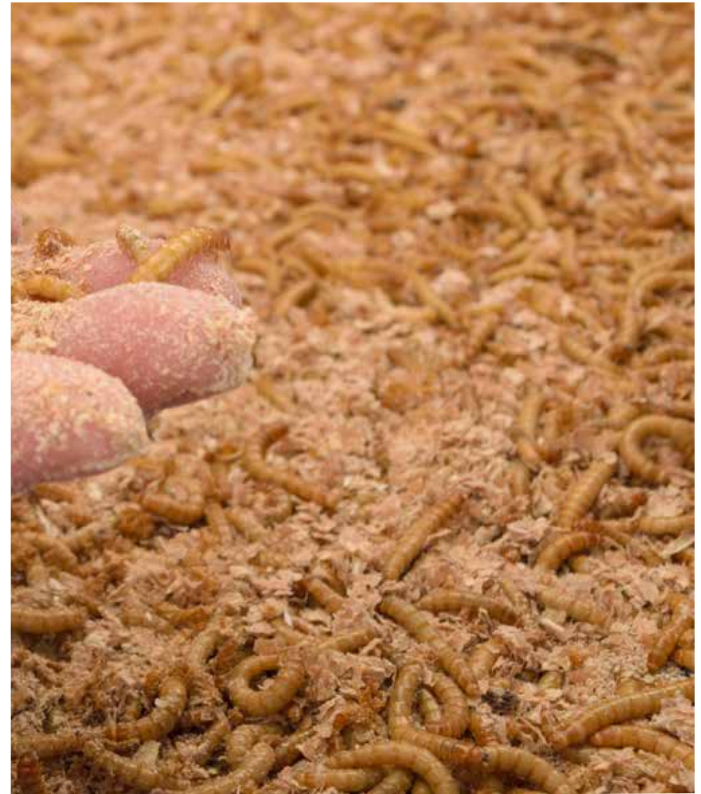
Crop research in UK is also aimed at increasing the protein content, the digestibility of the protein, the amino acid profile and new extrusion technology is increasingly playing a part in voiding the anti-nutritional components.

“Secondly, we are growing more high protein crops in the UK, in Europe, like peas and beans. They are clearly a potential replacer for soy, but they're not so easy to yield in a European climate. So, there are projects and initiatives to breed varieties of peas and beans that will grow more effectively.”

Clearly these must be economic for farmers to grow, but schemes like ELMS (Environmental Land Management Scheme) here in the UK will increase interest. And there is now also the option of a hi-pro soy crop in Europe (see the July edition of Milling and Grain – Page 52).

The UK government has signalled its intention to replace both the Basic Payment (BPS) and Countryside Stewardship (CS) schemes with an Environmental Land Management Scheme (ELMS), scheduled for launch in 2024/2025, which is being developed under the principle of paying farmers public money for public goods.

“From our point of view as feed producers, if it becomes economic for farmers to grow them, then as far as we're concerned there is a market for them in feed,” says Mr Major, adding that the feed sector was looking at other soy alternatives too – lupins and sunflower meal as well as other high protein alternatives such as synthetic amino acids. But the third group is the interesting one, and there are three contenders.



“Two of them you probably expect which are insects and algae, but we shouldn't ignore the potential reauthorisation of processed animal proteins (PAP),” adds Mr Major.

PAP is more of an alternative than novel, because it's only really novel in the sense that it's about to be reauthorised.

The EU is about the lift the original feed ban, so that will effectively allow the feeding of porcine PAP into poultry, and poultry PAP into pigs, under certain conditions, he says. Which as far as feedmills are concerned, will mean separate production facilities, where zero DNA cross-contamination and PCR testing will be key. Obviously, no one wants to see a replay of BSE.

In the UK, the legislation that prevents PAP being used as feed is under the control of FSA (Food Standards Agency), and the industry is in discussion now. There is a technical and supply chain element, and clearly a consumer view on it, but if the industry is seriously looking at reducing the reliance on soy and reducing carbon footprints, then PAP certainly looks like a very good raw material alternative.

“The first step is to make it legally possible, and then it will be a discussion with individual supply chains and markets that will have different views on it,” says Mr Major.

On the other hand, PAP legislation also covers use of insect PAP.

All the feed industry plus many food producers are looking at insects. However, there is a second and possibly more challenging part of the legislation, which is what the insects can themselves be fed.

Clearly if we're going to feed insects on animal feed grade materials then what's the point? We might as well feed those feed grade materials to the animals directly, because one of the big advantages is that insects can consume waste streams.

“We will end up having access to an insect protein meal, of which the dried larvae of soldier flies are presently the most common. The general view is that the legislative and technical hurdles can be overcome ... so now it's just a matter of time,” explains Mr Major.

To some extent the same thing applies to Algal biomass which, whilst perhaps most interesting to big agriculture as a potential carbon capture technology, can produce a high protein material. The feed component is what's left after some of the high value fractions have been taken out such as oils used for cosmetics or other uses for example, and then the dried by-product represents a valuable protein source.

But again, the question hangs over its scalability, although there are several projects sufficiently well developed to indicate that scale production is possible.

“Over the next five years we could see production at some sort of scale that would make it worth using within the in the feed industry,” notes Mr Major.

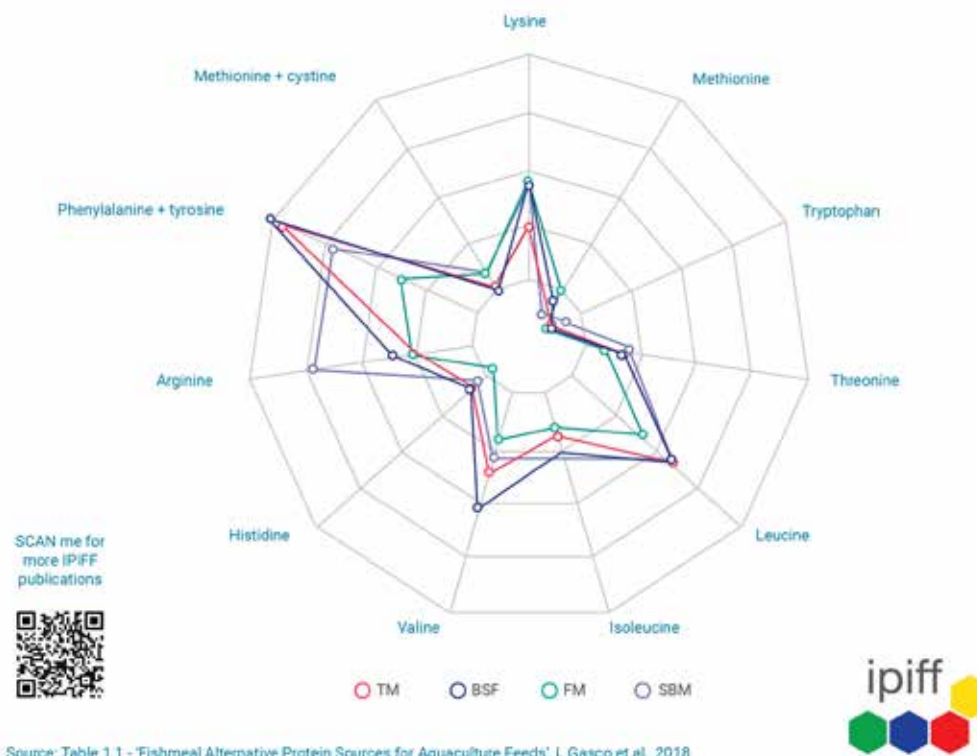
ForFarmers are presently undertaking trials using algae and have found a great advantage in compound feed in that there are so many different strains they can (almost) dictate a desired amino acid profile.

“Both insects and algae, we're all looking at them; they will come on stream over the coming years. But it's important also to be realistic, short to medium term we're going to need to carry on using soy, as these alternatives aren't going to be available to us in scale, certainly in the next three-to-five years,” says Mr Major.

“Remember, we are nutritionists, so what we're looking for is economic sources of highly digestible amino acids. So, to some extent, from our point of view, whether that comes from soy or algae or insect protein or processed animal protein, doesn't matter.



## Mean amino-acids for commonly-used insect meal, in contrast to fish meal or soybean



“We’re looking at accessing nutrition at the best cost, because we also have to ensure our livestock producers remain competitive in Europe and around the world,” Mr Major adds.

### Insect protein is more than just the acceptable face of PAP

The high content of digestible protein in dried insect larvae makes them a potent solution to improving protein self-sufficiency in animal feed.

Whilst many westerners may find the concept of eating insects repulsive, consumption and farming of insects, in South America and Asia for example, is commonplace, and has been for hundreds if not thousands of years. In many of these regions, legislation is absent or patchy.

In Europe insects are classified as farmed animals and can only be fed with feed ingredients that are authorised for farmed animals, such as plant origin material, eggs, milk and derived products.

This has created several challenging issues, for example insects cannot be fed with former foodstuffs containing ingredients of

animal origin – on the other hand, insect protein may not be fed to farm animals, except for aquaculture species.

A new report published by the UK’s largest retailer Tesco and environmental charity WWF, says total demand for insect meal from the UK’s pig, poultry and salmon sectors could reach around 540,000 tonnes per year by 2050. But, as well as a plea for public funding, it calls on the UK government to research the potential and regulatory requirements for adding extra substrates for insect farming.

Insects are fed with a mix of by- and co-products from the agri-food industries and with resources that are currently not being used and not or no longer destined for human consumption, such as the so-called ‘former foodstuffs’. These by- and co-products may also include those derived from grains, starch, fruit and vegetable supply chains.

But to upscale insect production it is essential that wider use of former foodstuffs is legalised. In addition, feeding insects with such foodstuffs can play a major role in reducing food waste that might otherwise end up rotting in landfill.

Adriana Casillas, President of IPIFF (International Platform

of Insects for Food and Feed) and co-founder of TEBRIO, a Spanish company, is leading the industry in raising and transforming the *Tenebrio Molitor* beetle larvae, or yellow mealworm (YMW).

TEBRIO extract protein and the lipids from the larva then finished products enter feed markets. Their amino acid profile corresponds to the dietary needs of fish, poultry or swine animals, with adequate levels of amino acids which are seen as limiting factors (lysine, threonine, methionine and tryptophan).

As with all other European insect producers, TEBRIO is governed by the same piece of legislation that controls PAPs so their market is presently limited to aquaculture and petfood. Fertiliser is also a valuable byproduct from the waste produced by the growth cycle.

“IPIFF expects that in September or October, the European Commission will say OK to the use of these insect proteins in poultry and pig, and on another hand, of course, it has to be in relation with products that companies can take to the market,” Ms Casillas explains.

Her start-up is presently building one of the largest mealworm factories in the world, with 60,000 square metres facility, to produce a staggering 100,000 tonnes of insect products annually. Similar start-ups have appeared across Europe and the UK in the last 10 years or so it’s easy to scoff at these bold predictions, but we only need to consider that in the 1950s, only around one million chickens were eaten in Britain each year – a figure that is now closer to one billion.

Ms Casillas is motivated by producing within a circular economy where resources are used and recycled by complimentary industries, because as she observes, “There are no new materials on the planet to feed the world. On the other hand, it should be sustainable, we have no other chance.”

The YMW emits neither methane nor ammonia and the carbon footprint is negative. In other words, their existence is entirely beneficial to the environment. In addition, they produce zero waste, contributing to the circular economy. “All products are sold and there is no residue left,” Ms Casillas adds.

### Investment in insects

Holding the industry up is a matter of investment in the processing technology to enable companies to be competitive on price and plenty of insect PAP on the market.

But scaling up is definitely not a problem. Several food companies have demonstrated serious interest in these proteins. Last year US agribusiness group, Cargill announced a partnership with French biotech firm, InnovaFeed, which together are aiming to feed 20 million piglets with insect oil by 2026. Meanwhile another French company, Innovafeed has raised a total of US\$200 million in investments.

“There is a lot of money out of there,” states Ms Casillas, but she also emphasises that insect PAP will come down in price.

“Today, there are not big quantities on the market, because it is a very new industry. So, we also need time to develop efficiency, but it shouldn’t be expensive. I calculate that in 10 years this could be a commodity, so the price should be totally competitive in 10 years, competitive with other protein products that are already in the market,” she explains.

According to a recent report (Rabobank, EU Joint Research Centre), the European insect sector’s production capacity is

expected to be between half and 1.5 million tonnes of insect protein by 2030.

“We believe that in the scale up phase, there won’t be a sharp decline in the price of insect protein. So, we expect prices to range from €3500 to €5500 (US\$4100 to US\$6400) per metric tonne. However, we expect prices to drop by €1000/tonne (US\$1170/tonne) after the industry completes the initial scale up phase, and by another €1000/tonne when the sector reaches maturity,” the report says.

### YMW - a perfect replacement for fishmeal

There is a problem today in that fish capture, such as anchoveta, for fishmeal are being significantly reduced and is likely to reduce further. The old adage ‘plenty of fish in the sea’ is simply no longer true. The goal of the insect producers is not simply to reduce soymeal use, it is about conserving all natural resources.

Conservationists claim the feed conversion rate for fishmeal is poor – up to four kilograms of anchoveta to feed another species like trout, to just to gain one kilogramme new fish. If so it’s very inefficient.

There is a very clear relationship between the Black Soldier Fly Larvae (BSFL) and soymeal, in terms of the amino acid profile



and the impact it has on infant growth. The motivation driving the growth of the insect sector is not about simply reducing reliance on soy, but about reducing exploitation of all natural resources, especially fishmeal. Ms Casillas is keen to point out that the amino acid profiles of YMW and BSFL are quite different.

“There is very clear relationship BSFL with soy, incorporation of amino acids, basically the impact that has on the growth of the fish, etc. But in the case of mealworms, for example, we have a very important paper in front of fishmeal. For example, there are a lot of animals, like fish, pork or chicken, that in some moment of their life they can be fed on fishmeal,” Ms Casillas explains.

YMW can be compared to the best fishmeal while BSFL can be compared with soy. Protein content and digestibility are much higher in YMW, and a totally different in fatty acid profile; while YMW has more than 75 percent unsaturated fatty acids, BSFL has around 75 percent saturated.

Moreover, their amino acid profiles correspond to the dietary needs of fish, poultry or swine animals, with adequate levels of amino acids which are seen as limiting factors (lysine, threonine, methionine and tryptophan).

Mealworm is also a much better conversion than fishmeal,

around 25 percent more growth on the fish by exchanging one for the other, so we don't necessarily need fishmeal to feed fish. We could achieve this with insects.

### Novel proteins are hard sell to UK pig producers

Meanwhile, the UK pig industry is largely taking the view that it's much better to work with the countries that are producing soy, through bodies such as the Roundtable on Sustainable Soy, rather than just demonising soy; albeit looking for alternative protein flows that are potentially going to be cheaper because soy is still expensive.

In the UK, pork is among the cheapest meat on supermarket shelves, as low as UK£4/US\$5.5 per kilo in Tesco for pork loin. So, what are the economics of using novel feeds in pig farming?

“We normally say that pig price equates to wheat price. And when they're not similar, then pig farmers are losing money. It depends on who you sell your pork to, but if the two figures are quite adrift it is a problem,” explains Dr Zoe Davies at the UK's National Pig Association (NPA).

The point is we only eat 40 percent British pork in the UK, which is important, so you know there is always an opportunity for British pork producers to supply more to the domestic market.

“But the issue that we've got is that we have a problem called carcass balance so we can't sell the whole pig on the UK market, we must export some, so that restricts what we can produce.

“We also have a huge demand for bacon. We have a demand for about 22 million loins, and we produce about 10 million. So, we have to import a certain percentage as well,” Dr Davies explains.

The UK also has a growing export market which has been very lucrative in the last few years, especially to China when it was impacted by the recent African Swine Fever outbreak. Their herd has now recovered and the price of pork in China has dropped.

But here's the key point – pork markets are so intertwined that, to be competitive feed costs must have parity. So does China, or anyone else for that matter, care what a pig eats? After all, feed is not something you see on the ingredients list on a packet of pork chops.

“The retailers definitely care what your pig eats, and if it was up to them pigs would basically eat organic only, but that's not possible and would price most pork out of the market,” adds Dr Davies.

“Gone are the days when the UK consumer would be happy for a pig to eat a swill that has God knows what in it ... retailers are very strict about what can go into a diet, and obviously the law directs us at the moment, but from NPA point of view, we don't have any issues with pigs being fed poultry meal and poultry being fed pig meal, there's no scientific issue with it, there's no

health risk associated with it, they've never been associated with TSE's (Transmissible Spongiform Encephalopathies), unlike the ruminant sector.”

While the pig industry would need to get approval from retailers who would in turn need to scope out consumer acceptance, Dr Davies points to a complete absence of pig-only feedmills using PAP. “It's just not going to work, it's not like this product is currently going to waste.”

And while insect meal will be acceptable from a consumer point of view, the high cost means it will probably benefit the poultry sector before the pig sector, and we should bear in mind that half the PAP is currently going into valuable petfood, so there will not be a sudden, large and very cheap protein source available, he adds.

“Most protein sources, when they come online, just find their level amongst all the other protein sources ... and there's a problem with soy, in that it's a perfect protein source for pigs. It has a very good amino acid profile and a very good ratio of what the pig actually needs,” Dr Davies notes.

### Novel protein costs to come down

It's time for feed millers to embrace new proteins, but one thing is clear; there is a gap between what the feed miller needs and the lack of scale/ high cost in the novel protein sector.

Consumer perception of insect protein seems to be generally quite supportive, after all what's more natural than poultry, for example, eating insects? It's what they do in their natural environment.

But does the consumer want meat reared on PAPs? It may depend on the degree to which the industry can put forward the science and explain how it's different to the situation that led to mad cow disease (BSE), which was ruminant based. Pigs and poultry are omnivores and therefore viewed objectively, in theory, there's no reason why it shouldn't be okay.

But insects and algae will play their part in the near future in replacing some, but certainly not all soy, simply because the feed industry works on formulating rations based on price, availability and nutritional specification.

Novel proteins will find their place in feed formulations, but to be a serious contender to soy and fishmeal, its level of sustainability will need to improve as the sector scales up. Policy makers, retailers and producers can also effect change by being willing to pay more for protein, because if they don't, then this could simply be a case of too many words and too few deeds to bring about the change needed to address the fundamental protein dilemma facing the planet.



Nick Major - AIC UK, FEAC and ForFarmers, The Netherlands



Dr Zoe Davies - UK National Pig Association, UK



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