Tackling poultry industry research challenges

EPSRC Engineering and Physical Sciences Research Council

BBSRC bioscience for the future

Funding from BBSRC and EPSRC has supported collaborations between poultry researchers at Nottingham Trent University (NTU) and industry partners AB Agri and Alltech to address several challenges identified by the bioethanol and poultry industries. The Research Council funding also contributed towards the establishment of a new poultry research unit and training for researchers to meet a critical poultry industry skills need.

BBSRC and EPSRC support has enabled researchers at Nottingham Trent University (NTU) to establish a new poultry research unit and to train researchers to meet a critical poultry industry skills need. The funding also enabled them to address several challenges facing the bioethanol and poultry industries.

The researchers, led by Dr Emily Burton[1], received two studentships from the Research Councils. The first, an EPSRC Industrial CASE studentship, enabled the researchers to work with industry partner AB Agri[2] to investigate whether other products, known as 'co-products', from bioethanol manufacture could be converted into poultry and fish feed.

Chicks at the NTU Poultry Research Unit.
Image: *Dr Emily Burton/Nottingham Trent University*

The project subsequently received Knowledge Transfer Partnership[4] funding and a Technology Strategy Board[5] grant. AB Agri are also utilising the unique expertise and facilities at two Institutes that receive strategic funding from BBSRC; the Institute of Food Research[6] in Norwich, and the Institute of Biological, Environmental and Rural Sciences at Aberystwyth University[7].

In parallel with the EPSRC funding, the NTU researchers were also granted a BBSRC Industrial CASE studentship, which enabled a student to work with animal health company Alltech UK[3] to establish the mode of action of a prebiotic chicken food supplement.

"I've always had a close relationship with industry," says Burton, Senior Lecturer at NTU and project supervisor on the two Research Council studentships. "That allows us to really understand the problems and challenges they face, so we try to direct research projects to focus on problem-solving."

High value co-products

The first studentship, an Industrial CASE award from EPSRC[8] funded under the Research Councils UK Energy Programme[9], allowed Burton and Dr Peter Williams, Business Development Manager - Biofuels at AB Agri, to begin to explore whether they could extract high value protein for use as poultry feed from the co-product generated during the production of bioethanol.

80Bn litres of bioethanol were produced globally in 2012[10]. Bioethanol is produced from grain, mainly corn or wheat, and makes up around one third of the output of the production process. Another third consists of carbon dioxide, and the final third is a feed co-product called distiller's dried grain and solubles (DDGS), which contains the yeast that has grown during fermentation and is rich in protein. However, the valuable protein component of DDGS is tightly associated with fibre, making it difficult to extract and use.

IMPACT SUMMARY

Research Council funding for Nottingham Trent University enabled the creation of a new Poultry Research Unit. Researchers trained at the Unit are helping to alleviate a shortage of skilled postgraduate researchers for the UK poultry industry.

One of the projects, supported by EPSRC, enabled industry partner AB Agri to develop a process to separate high value protein from the co-product generated during the production of bioethanol and use it as fish and poultry feed. The research subsequently received Knowledge Transfer Partnership funding and a £1.5M Technology Strategy Board grant, and now involves researchers and facilities at two Institutes supported by BBSRC.

The second project, supported by BBSRC, identified a mode of action of a prebiotic used by the poultry industry to boost gut health and reduce the need for antibiotics.

Currently, most of the DDGS is fed to cattle, which can tolerate the high fibre content, but AB Agri was interested in extracting the protein for use in higher-value markets.

"We saw the potential in the yeast to produce a novel protein for animal feed," says Williams.

The EPSRC-funded PhD student, Dawn Scholey, characterised the nutritional value of the protein-rich liquid fraction of the co-product and showed that it would be suitable as poultry feed, as well as looking at how it could be extracted from the bioethanol production process[11]. According to Williams, "We couldn't have got this development started without the EPSRC CASE studentship, which allowed us to establish the proof of concept."

A Knowledge Transfer Partnership (KTP) with Plymouth University then allowed Williams to demonstrate that the protein could be fed to fish such as farmed salmon. Around 158,000 tonnes of salmon, worth £585M, were farmed in Scotland in 2011[12].

As well as studying the liquid fraction of the co-product, Williams was also interested in the protein content of the solid fraction. In 2011, AB Agri won a grant[14] from the Technology Strategy Board, as part of a consortium, to investigate whether they could extract the protein from this solid fraction. As well as several companies interested in the technology, the consortium also included biorefining experts from the Institute of Food Research, whose role was to study the basic biology of the protein in the fraction. The researchers now plan to test the material being developed by the IFR team in poultry at the Poultry Research Unit at NTU. Since the Technology Strategy Board project began, "we have made considerable progress in recovering another high-value protein stream," says Williams.

In 2014, AB Agri began processing raw material from a commercial partner in Europe using the unique facilities at the BEACON Biorefining Centre of Excellence[13] managed by the Institute of Biological, Environmental and Rural Sciences (IBERS) at Aberystwyth. In particular, AB Agri are using industrial separators at the BEACON, usually used for processing grass at IBERS, to extract the high protein fractions.

According to Williams, "Overall, we have made phenomenal progress, to the point that we are now looking to say that there is a bioprocessing opportunity where grain will be processed to produce alternative proteins, and bioethanol will be the co-product. It's the same model as soya bean which was originally processed to produce oil but is now grown for the meal. The key is that our bioprocessed meal will be produced from a non GM English wheat crop and will replace imported soya bean meal."

Antibiotic replacement

In parallel with the EPSRC studentship, Burton also supervised a BBSRC industrial CASE student, Harriet Lea, working with animal health company Alltech UK to better understand the mode of action of their prebiotic yeast

NTU researchers Dr Emily Burton (L) and Dr Dawn Scholey (R). Image: *Dr Emily Burton/Nottingham Trent University*

> **“The global market for prebiotics in animal feed was worth around £128M in 2012[16]**

supplement, designed to support a healthy gut in poultry[15]. The global market for prebiotics in animal feed was worth around £128M in 2012[16].

“The poultry sector faces a lot of problems trying to maintain gut health in such a vulnerable species,” says Burton. “It was previously controlled by in-feed antibiotics, with a knock-on impact on antibiotic resistance. The industry voluntarily underwent a reduction in the use of antibiotics, before it was banned, and there was a scramble to find another way to support gut health in poultry.”

Alltech’s prebiotic product is made from small, purified remains of yeast cell walls and is designed to provide a substrate for beneficial gut microbes, helping the gut to keep itself healthy. However, the complexity of the gut environment and the populations of microbes it contains meant that the specific mode of action for the prebiotic was unclear.

The student, Lea, was able to identify one of the modes of action of Alltech’s product. The study revealed that the prebiotic increased the surface of area of goblet cells in the gut, which produce mucin, part of the gut’s natural defence against infection[17]. Alltech were able to use the finding in their marketing for the product.

A sustainable poultry industry

The initial funding from EPSRC, and subsequent funding from BBSRC and elsewhere, also enabled Burton to establish a new poultry research facility.

“When I began contacting industry… the first thing we got was the EPSRC CASE studentship,” says Burton. “Landing that studentship allowed us to build a small, simple poultry research facility. It got us going, and now we have a huge programme that was built out of that.” The studentship included an industry contribution of £50K, which Burton used to establish the Poultry Research Unit at NTU. Subsequent funding has helped enlarge and develop the Unit.

The two CASE projects also contributed to meeting the skills needs of the European poultry industry, which is currently suffering from a lack of trained postgraduate researchers[18]. Burton is keen to ensure the poultry industry is sustainable, in the broadest sense, and ensuring a supply of highly skilled researchers to meet industry needs is an important goal for her and for the Poultry Research Unit at NTU. “It is good to provide solutions to the industry, but we also aim to provide a pipeline of scientists into a sector that is incredibly short of skilled people,” Burton explains.

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