An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine

Irish Partnered Research Projects Supported by DAFM's Research Programme under the US-Ireland R&D Partnership

Year	Lead Irish Partner, Lead Institute + Other Collaborating Institutions	Project Title, (Acronym) and Summary	DAFM Grant Award to ROI Partners
2020	Dr. John Kenny, Teagasc Other Collaborating Institutions: University College Cork Queen's University Belfast University of Wisconsin-Madison	**Improved Pig Health through the Novel Application of SynBio in Phage Therapy. (PhageSUAS)** Streptococcus suis is a pig pathobiont that is almost ubiquitously carried in the nasopharynx. S. suis infection is most commonly associated with a previous intestinal or respiratory infection, leading to S. suis-mediated meningitis, polyarthritis, septicaemia, pneumonia and endocarditis. As a consequence, S. suis infections are a significant international animal welfare and economic burden in the pig industry. This project is expected to yield innovative and effective phage therapy solutions to specifically target S. suis in pigs. We will use a rational design approach to generate and test phage cocktails. This design will allow the phages in the cocktail to kill a wide range of infectious S. suis strains while circumventing bacterial-mediated phage resistance, a key roadblock to the use of phage therapy (PT). Simultaneously, we will develop the Generally Regarded As Safe (GRAS) gut symbiont Lactobacillus reuteri as next-generation probiotics to deliver antimicrobials to eradicate S. suis from the pig gastrointestinal tract.	€342,190.20

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2018	Dr Bernadette Early, Teagasc Other Collaborating Institutions: Agri-Food and Biosciences Institute USDA/ARS/US Meat Animal Research Center	**Bovine Respiratory Disease Complex - Upper Respiratory Tract Microbiome & Virome Project. (BRDC-URTMVP)** Bovine respiratory disease complex (BRDC) (pneumonia) is one of the most significant health problems in cattle and one of the biggest costs to the beef industry. The etiopathogenesis of BRDC is multifactorial and extremely complicated; it is caused by an array of infectious agents (viruses, bacteria and Mycoplasmas), interacting with environmental and management factors, which can enhance transmission, as well as, create 'stressors' that adversely affect the host immune mechanisms. This, in turn, may predispose calves to secondary viral and bacterial infections. Despite decades of research, effective immunization or antimicrobial therapies have not been developed that substantially reduce the prevalence or severity of BRDC. Fundamental to the creation of appropriate prevention and treatment regimens for BRDC are rapid, comprehensive, targeted and untargeted diagnostic tests coupled with information pertaining to the timing of onset of host immunodeficiency, the particular immune defense mechanisms involved and the dynamics of secondary infections; however, appropriate diagnostic technologies are presently unavailable and this crucial information is largely unknown. In this multidisciplinary project, we aim to i), investigate the prevalence and distribution of the respiratory microbiome and virome associated with BRDC in beef and dairy herds in Ireland and in beef herds at the United States Meat Animal Research Center (US MARC); ii), develop methods to accurately identify the infectious agents of BRDC using next generation sequencing (NGS), third generation sequencing (TGS), bioinformatics technologies, and high-throughput sensitive and rapid pen-side diagnostics; and iii), elucidate the dynamics of secondary viral and bacterial infection by monitoring experimentally virus infected animals in longitudinal studies (AFBI, N. Ireland).	€349,610

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2017	Professor David MacHugh, University College Dublin Other Collaborating Institutions: Queen's University Belfast Recombinetics, Inc.	**Targeted genome editing to enhance genetic resistance to Mycobacterium bovis infection in domestic cattle populations (TARGET-TB)** This tripartite US-Ireland R&D Partnership project will leverage complementary scientific skills, resources and infrastructure available at the College of Health and Agricultural Sciences, University College Dublin, (ROI-UCD), the Centre for Experimental Medicine, Queen's University Belfast (NI-QUB) and Recombinetics, Inc., Minnesota (US-REC). The overall goal will be to identify key genes associated with the bovine host response to infection with M. bovis and use this information to develop methods for gene editing of production cattle populations. The research project will also generate new information on the genetics of host-pathogen interaction for BTB that will improve existing control and management tools such as diagnostics and genome enabled breeding. In addition, it will define a research model that can be used for comparable studies of other important mycobacterial livestock diseases such as Johne's disease caused by infection with M. avium subsp. Paratuberculosis (MAP). The project will use computational analyses to transform high-resolution gene expression data into knowledge, which can be used to prioritise genes for genome-editing experiments in livestock. A scientific pipeline will be developed and implemented for robust functional testing of gene edits in bovine induced pluripotent stem cell (iPSC)-derived macrophages (iPSDM) using an in vitro infection model system. These cells will be used to identify bovine target genes that can be used to generate genome-edited cattle with enhanced resistance to M. bovis infection and reduced population incidence of BTB disease.	€325,115
	Dr. Susan Joyce, University College Cork	**Improved Animal Husbandry through Inhibition of Microbial Bile Salt Hydrolase (NAGpro)**	€301,874

	Other Collaborating Institutions: Queen's University Belfast University of Tennessee	We propose to develop innovative antibiotic-free feeding technologies (growth promoters) that will enhance weight gain in chickens to significantly improve yield, enhance profitability and deliver a product of enhanced quality to the consumer. We predict that the work will also have significant potential for applications in other animals. Novel growth promoters will be based upon our recent functional microbiome work and emerging understanding of how gut bacteria interact with the host to control weight gain. In particular, we have previously identified bacterial enzymes called Bile Salt Hydrolases (BSHs) which modify bile acids in the host and influence energy metabolism. Compelling evidence shows that inhibition of BSH activity would cause weight gain. On this basis, we will develop a world-leading research program that will develop BSH inhibitors showing promise as animal growth promoters in this project. We also will test these novel growth promoters in a chicken husbandry model and will investigate the biological basis of the phenomenon using state-of-the-art metabolomics, metagenomics and computational approaches. The proposed work directly addresses the AFRI Priority Program Area of A1231 (Animal Nutrition, Growth and Lactation). Using multidisciplinary approaches, this timely project will be conducted by a team of highly experienced investigators in the USA, Republic of Ireland, and North Ireland. The outcomes of the project will lead to the development of innovative non-antibiotic technologies for use in poultry and possibly other livestock. Adoption of our antibiotic-free strategies will undoubtedly improve food safety and reduce the dependence on in-feed antibiotics while maintaining animal productivity and sustainability.	
	Professor Alan O'Riordan, Tyndall National Institute, University College Cork Other Collaborating Institutions: Queen's University Belfast Georgia Institute of Technology	**Development and validation of an on-farm, electronic disease diagnosis platform for cattle (AgriSense II)** The effective and early detection of disease within cattle is widely recognized as a critical component in maximizing clinical and therapeutic outcomes, increasing production efficiency and limiting the economic impact of infections. AgriSense II will develop an electronic sensor platform consisting of two sensors with different sensing mechanisms (potentiometric sensors based on field-effect-transistors and electrochemical impedance) which can be co-fabricated on the same substrate that	€349,999

		will greatly reduce false positive and false negative test results therefore providing more robust clinical data to stakeholder such as farmers and veterinarians. The device will target multiplexed (simultaneous) detection of commonly occurring viral pathogens known to cause production diseases that have high animal welfare and economic costs. These diseases include: Bovine Viral Diarrhoea (BVDV), Bovine Parainfluenza Virus-3 (BPIV-3), Bovine Respiratory Syncytial Virus (BRSV), and Enzootic Bovine Leucosis (EBL).	

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2016	Sinead Waters, Teagasc Other Collaborating Institutions: Irish Cattle Breeding Federation Agri-Food and Biosciences Institute University of Missouri	**Application of next generation sequencing for the identification of DNA based biomarkers in regulatory regions of the genome for susceptibility to bovine respiratory disease complex (BRDC-Seq)** Endemic disease is one of the most serious threats to the ambition of the agriculture and food industry in Ireland and increasing intensification of production systems has the potential to exacerbate this. Bovine respiratory disease complex (BRDC) is the most common economically important disease affecting cattle worldwide. BRDC, also known as pneumonia, is the largest cause of mortality in calves aged one to five months old in Ireland. To develop accurate diagnostics that can predict disease susceptibility/resistance, it is essential to clarify the molecular mechanisms that underlie BRDC in the host animal. This project aims to gain a greater understanding of the complex interactions between the bovine host and the multitude of viral and bacterial pathogens, as well as the environmental factors associated with BRDC infection in dairy calves. BRDC-Seq will utilise this key information for the identification of robust DNA based biomarkers to be employed via the genomic selection breeding programme.	€345,591