Ulster University

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Human Microbiome Solutions to Fight Infection & Prevent Disease

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The human gut microbiota consists of a complex population of trillions of microorganisms including bacteria, viruses, and fungi that reside in the human intestine. This is an area of research that has been transformed in recent times, with studies demonstrating the important and central role which is played in host health and disease status. Indeed, such is the impact of Microbiome Research is that it is almost redefining how we look at many disciplines including Microbiology, human nutrition and medicine (particularly infection). A good start in life is important and the human microbiome is established from birth where it undoubtedly has a profound impact on early infant health and indeed probably on later life. Indeed, we believe that the microbiome has a "memory" in that microbial signatures of the microbiome at 4 years of age may even reflect early perinatal experiences and events. Many health conditions are associated with changes in the microbiome ranging from infection, obesity and diabetes to cancer and even depression. In many cases, ill-health and aging are associated with major changes in the composition of the human microbiome and are often characterized by having a reduced diversity at the genus level. It is now apparent that the relationship between diet and the intestinal microbiota impacts upon host metabolic activity and phenotype on a range of levels including across the brain/gut axis. Consequently, there is an increasing need to focus on approaches whereby the microbiome can be modified in a positive manner from a compositional perspective.

At APC Microbiome Ireland, we are adopting a number of strategies to influence the microbiome towards improved health outcomes. These include the use of specific dietary interventions ranging from dairy ingredients to complex carbohydrates to novel antimicrobial strategies utilizing bacteriocins and bacterial viruses (bacteriophages). Bacteriocins are ribosomally synthesized peptides produced by bacteria which kill other bacteria. Many of these are narrow spectrum and only kill related species of microorganisms. One such bacteriocin produced by *Bacillus thuringensis* is called thuricinCD and is particularly effective against *Clostridium difficile*. Indeed, we have shown that this bacteriocin can reduce numbers of the pathogen from the microbiome without causing the collateral damage associated with antibiotics such as vancomycin and metronidazole. We believe that such strategies will allow the sculpting of the microbiome composition in a precise way to deliver functionality for improved health outcomes.