Pathogenic bacteria are a major health problem in modern food production. To identify new ways of controlling them, scientists in Norway have begun to conduct experiments using the unique new Pathogen Pilot Plant. Combining the attributes of an industrial production line with laboratory style biosecurity features, its resources allow researchers to observe lethal bacteria in realistic contexts, thereby learning how to better control them

A new, unique facility for developing safer food production

Despite their appetising appearance, some of our favourite morsels may contain unseen dangers. Foodborne disease, or 'food poisoning', caused by harmful bacteria is a significant health hazard across the globe. Amongst these virulent organisms are widely publicised species such as Salmonella, Listeria and E. coli, a variant of which recently caused a dangerous outbreak of hemolytic-uremic syndrome in Germany. For food scientists, episodes such as these provoke questions about the safety of foodstuffs. "In 1999, we explored the possibility of creating a national research facility, where you could test pathogens in food," recalls Dr Helga Næs, head of the Food Safety and Quality Department at Nofima, a Norwegian research and development institute working in the country's aquaculture, fisheries and food industries. "But, due to a lack of funding, nothing happened. In 2006, the situation began to change due to a national outbreak of pathogenic E. coli in fermented sausages. This resulted in hospitalisations, and one death".

The seriousness of this outbreak led national producers of fermented sausage products to initiate a scientific collaboration with Næs and her colleagues in order to explore safer means of production. The project established a mini factory for dry fermented sausages on laboratory premises, and exposed their creations to pathogenic E. coli and several other additives to examine the evolution of the bacteria. "We tried various strategies," says Næs, "which included varying the amount of sugar and salt in the products, as well as changing fermentation and storage temperatures to see how this impacted on bacterial survival. Numerous other techniques were also tested. One post-production technique involved applying a pressure of 6000 atmospheres to the sausages, which was abruptly reduced down to one atmosphere. "This actually causes the bacteria to burst and die, so it's one means of controlling them that could potentially be applied commercially."

Another discovery that emerged from the research was that by exposing finished sausages to a gentle 43°C heat treatment for 24 hours, they became less likely to transmit disease due to a significant decrease in surviving E. coli bacteria. "From this encouraging starting point, we began to consider the idea of building a larger, more sophisticated factory-type lab environment which would allow us to apply this methodology to various food types, with the common goal of making them safer," says Næs.

Opened on 17 December 2013, the brand new Pathogen Pilot Plant has helped to realise these ambitions. Financed by the Research Council of Norway, alongside a research foundation and the Norwegian Ministry for Agriculture and Food, the building is situated at Nofima's location at Campus Ås, home also for the Norwegian University of Life Sciences, a close collaborator of Nofima in the realisation of the project. Its formidable resources are intended to provide a focal point for wide-ranging collaborations between academics, industry and Nofima, which could stimulate new innovations in food hygiene processes, cleaning and disinfection, and the packaging of finished products.

"Practically, the facility is quite unique," explains Askild L. Holck, a senior research scientist at Nofima. "It's more a food production setup than a laboratory, although it contains some tools for pathogen analysis. But the majority of its space is occupied by food preparation equipment. What is particularly exciting for us is that the building is compliant with Biosafety Level 3 standards. This means that it's a totally contained environment. Air is filtered, and always flows in when the doors are opened, preventing bacteria from escaping. Similarly, water is sterilised when it leaves, amongst several other precautions. This means that we can work with fairly dangerous bacteria while using industry-standard machinery in 'real world' configurations. This approach is an attractive alternative to other ways of conducting bacterial experiments, like developing model systems, or trying to replicate authentic pathogens. Because the non-pathogenic (so-called 'surrogate') strains may not behave identically to real ones, working with the actual bacteria which cause foodborne disease significantly improves the validity of our research."

The sensory enjoyment of the food does not go ignored by the scientists, which can complicate the implementation of processes that initially seem effective, but prove less appetising than expected. "When introducing decontamination procedures, it's important to ensure that they don't detract from the taste of foods," says Næs. "Because we have ample facilities available to us, we can actually produce the same products in parallel, under 'test' and 'control' conditions. Creating multiple variants also enables us to assess the qualitative impacts of new processes through sensory tests, performed by the well-recognised sensory panel at Nofima. These require subjects to assess properties such as the acidity of a food and identify their preferred flavours. Another related consideration is that, after exposure to a treatment, it is equally important that we ensure food retains its nutritional value."

Apparatus within the plant has been selected for its versatility so that it can be used for other common foods including meat, cheese, fish and fresh produce. "It's important to remember that outbreaks caused by these bacteria not only cause physical sickness but also have commercial ramifications," reminds Holck. "They may cause significant detriment to producers, including adverse publicity and costs due to recalls and waning sales. This can occur across many sectors, and so the facility has partly been designed to encourage cooperation between marine and agricultural enterprises. As such, we hope that the Pathogen Pilot Plant will prove inviting to a wide section of the food industry in Norway and beyond. It presents a singular opportunity for us to work with these people, alongside our students and other independent researchers." ★

AT A GLANCE

Project Information

Project Title:
Pathogen pilot plant – a new, unique facility for developing safer food production

Project Objective:
A new experimental facility of biosafety level 3, the Pathogen pilot plant, is established at Campus Ås, Nofima, Norway to facilitate studies on pathogenic microorganisms in food production, packaging and storage under realistic conditions. Methods in cleaning and disinfection of production equipment and premises can also be studied.

Project Duration and Timing:
The Pathogen pilot plant was opened in Desember 2013 and is now available for experimental work for scientific organizations and companies.

Project Funding:
The establishment of the pathogen pilot plant has received financing from The Research Council of Norway, the Research Levy on Agricultural Products (Norwegian Agriculture Agency) and the Norwegian Ministry of Agriculture and Food

Project Partners:
Senior Scientist Askild L. Holck, Nofima
Professor Elling Olav Rukke, Norwegian University of Life Sciences

MAIN CONTACT

Helga Næs
Helga Næs has a PhD from the University of Oslo. She has worked as a research scientist in the Meat Cooperation of Norway and as Industrial Adviser at Norwegian Trade Council. She started at Matforsk/Nofima in 1993 and is now Research Director of the Food Safety and Quality department. She has studied leadership at Sloan Business School, MIT, Boston.

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