CASE STUDY

FROM PLATES TO PRACTICE — ADAPTING BIOFILM TESTING TO FOOD INDUSTRY CONDITIONS

HOW THE QUADRAM INSTITUTE EVALUATED NEW APPROACHES TO BIOFILM ANALYSIS AND BIOCIDE TESTING USING BIOCALORIMETRY

Institute: Quadram, Norwich, UK
Research: Food and microbes interactions
Instrument: calScreener™

INTRODUCTION

The Quadram Institute, located in Norwich, UK, is a leading center for microbiome and food-related research. It brings together researchers, academics and NHS clinicians to address global challenges in human health, food and disease. At the heart of its work is a focus on understanding how microbes behave and interact, both with each other and within their environments.

Ongoing research includes exploring how microorganisms survive, persist, and interact within food production and processing environments. This includes studying how environmental factors such as temperature, surface materials, or nutrient availability influence the formation and resilience of biofilms, and evaluating strategies, such as antimicrobial coatings, to limit the persistence of foodborne pathogens like *Listeria monocytogenes*.

Figure 1. The calScreener™, enabling rapid and sensitive microbial detection through biocalorimetry technology.

"The calScreener allowed us to test microbial activity directly on surfaces and matrices, under conditions relevant to the food industry, with much less hands-on work. It helped us explore questions we couldn't easily approach with standard methods."

Dr. Maria Diaz
Research Scientist

EXPLORING NEW WAYS TO STUDY BIOFILMS

In biofilm research, even small environmental changes can cause major shifts in the structure and phenotype of microbial aggregates. Yet understanding these shifts is often difficult, as many traditional lab techniques rely on destructive sampling — breaking apart biofilms to measure colony counts, staining biomass, or measuring optical density. Each step risks losing valuable information about the intact community structure. Moreover, these methods are slow and resource-intensive, requiring multiple plates, repetitions, and manual handling to test even a few variables.

"We often want to ask big questions — like how a strain behaves across a range of nutrient and pH conditions — but the tools we used before made that challenging," says Dr. Maria Diaz, Research Scientist in the Quadram Institute's Microbes and Food Safety program. "You can only test a limited number of variables at once, and results can take days to obtain. The calScreener streamlines this process — fewer manual steps, but continuous insight into microbial activity."

Recognising these constraints, the team sought a complementary method that could capture microbial behaviour more directly — one that would reduce hands-on work while preserving the biofilm's native state. The calScreener provided a way to explore these questions continuously, revealing activity patterns that are often lost with traditional end-point measurements.

ACCELERATING TESTING WITH CALSCREENER BIOCALORIMETER

As part of a collaborative proof-of-concept study supported by NBIC, Dr Diaz evaluated the Symcel calScreener (Fig. 1), an isothermal microcalorimeter that measures real-time metabolic heat from living cells.

Up to 32 samples can be tested in parallel and each experiment yields heat-flow profiles that reflect bacterial metabolic activity in response to different conditions. These curves provide detailed insight into growth dynamics, stress responses, and potential synergies — without the need for optical density readings, plating, or destructive sampling. Biofilms growing on surfaces of interest can be tested directly in test vials with growth media (Fig. 2).

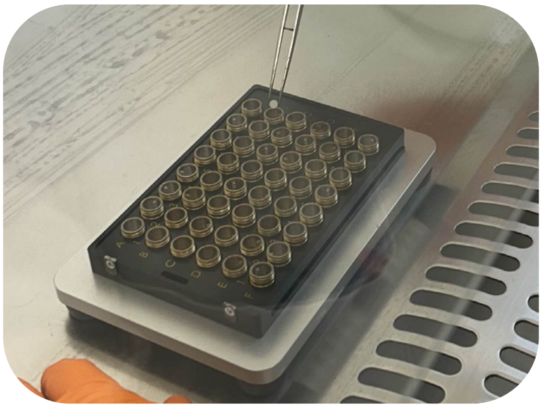

Figure 2. The calScreener enables microbial testing of undisrupted biofilms on solid or complex materials. Samples can be put directly in vials with growth media, evaluating effects of antimicrobial coatings.

MORE EFFICIENT RESEARCH, NEW INSIGHTS

The evaluation demonstrated the potential of the calScreener to support microbial biofilm testing workflows and provide complementary data to conventional methods. Instead of labor-intensive and manual plating, the team can simply place bacterial cultures or biofilms into the calScreener and let the system monitor the activity in real time.

This means they can start an experiment and return to other tasks, knowing there will be high-resolution data waiting the next day. As a bonus, the calScreener´s heat-based measurements offer novel insights that traditional plate counts can't provide, enabling richer datasets to work with.

"It gave us a complementary way to assess biofilms in a more natural state, and the continuous measurements helped us interpret microbial behaviour with finer resolution" Maria says.

The study provided valuable insight into how biocalorimetry can be applied to food environment-relevant biofilm research, highlighting its potential for future applications in food safety and hygiene studies.

A BETTER WAY TO TEST BIOFILMS

- Broader screening of microbial conditions with reduced manual handling.
- Non-destructive biofilm analysis – Study microbial behavior in native structures without disrupting the community.
- Rapid hypothesis testing – Ideas evaluated within 24–48 hours, helping the team make faster decisions.
- More creative science – Exploration of "what-if" questions that might have been overlooked.
- Detailed metabolic insight – Heat data revealing effects invisible to standard growth assays.

CONCLUSION

The Quadram Institute's collaboration with Symcel demonstrated the potential of biocalorimetry to advance microbial research by enabling non-destructive, continuous monitoring of biofilm activity under conditions relevant to the food industry. The study showed that the metabolic activity of *Listeria monocytogenes* and other food-associated microorganisms can be tracked at refrigeration temperatures, opening new opportunities to investigate how pathogens and spoilage organisms persist on surfaces and respond to cleaning or antimicrobial interventions in food processing environments.

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