

RAPID MICROBIAL DETECTION IN SKINCARE PRODUCTS VIA ISOTHERMAL MICROCALORIMETRY

INTRODUCTION

Maintaining sterility in consumer products is essential for ensuring both safety and quality. Across the personal care industry, brands are challenged with balancing regulatory requirements, consumer expectations for natural formulations, and the technical limitations of existing microbial detection methods. Traditional assays, such as culture-based sterility tests, often require several days before results are available, slowing production timelines and driving up costs¹. These methods can also struggle to detect very low levels of contamination, particularly in complex product types like viscous creams and oil-based formulations. Preservatives within these products may inhibit microbial growth during testing, leading to delayed or even false-negative results.

Isothermal microcalorimetry has emerged as a powerful solution for rapid sterility testing, enabling the detection of microbial contaminants with very high speed and sensitivity². Unlike conventional culture-based assays, which rely on visible microbial growth, microcalorimetry detects the metabolic heat released by microorganisms. This enables accurate detection within hours, even in complex formulations, and at contamination levels as low as a few colony-forming units (CFU). This method also allows direct testing of finished products, as well as in-process monitoring, without lengthy pre-treatments or destructive sampling.

For skincare brands developing topline formulations with minimal additives and preservatives, these advantages are particularly important. By limiting preservatives to keep products as natural as possible, ensuring sterility becomes a critical priority. This study was performed in collaboration with Bunnyroo Inc., highlighting how rapid, growth-based sterility testing can support the development of safe and preservative-light skincare products.

PROCEDURE

The aim of this study was to evaluate the microbial activity in two skincare products – a face serum and a collagen cream (Bunnyroo Inc., Toronto, Canada) using the Symcel calScreener biocalorimeter system. The procedure was developed to align with USP <62> and EP 2.6. Bacterial cultures were grown overnight. Each test product was mixed at a 1:10 ratio with TAT medium, which neutralizes product preservatives, and supplemented with concentrated TSB medium (Fig. 1). The products were spiked with approximately 20 CFU per gram of either *Pseudomonas aeruginosa* (P.a.) or *Staphylococcus aureus* (S.a.). Samples were transferred into calVials, measuring vials, and incubated in the calScreener at 37 °C for 24 hours. A product control without bacteria was also included. Microbial contamination was considered present when the metabolic heat production reached a threshold of 1 µW.

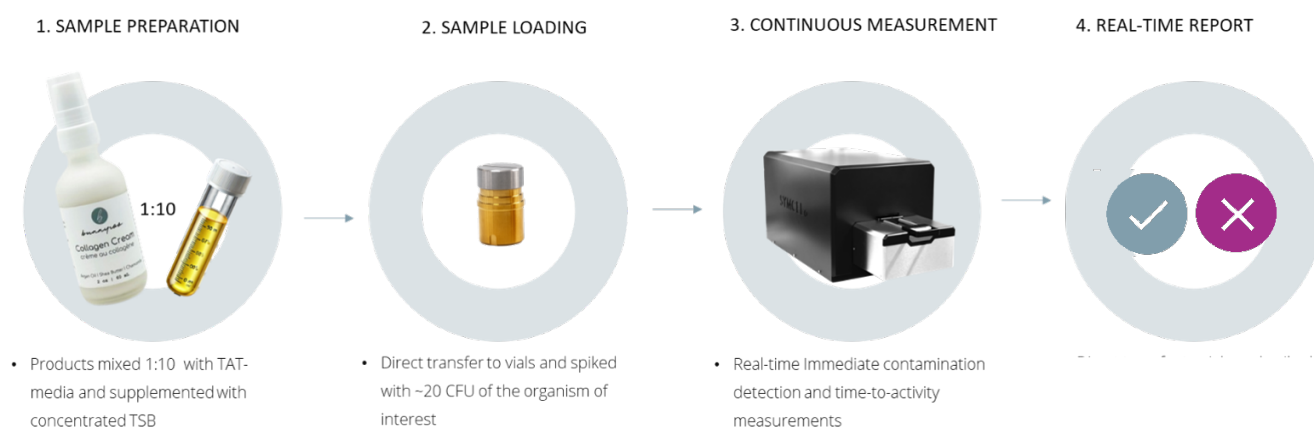


Figure 1. Testing procedure. Product samples kindly provided by Bunnyroo Inc.

PROTOCOL

1. Dilute bacterial culture to 10^4 CFU/mL
2. Spike 1 g product with 100 μ L bacterial dilution
3. Mix product with 9mL TAT+ 1.25 mL 8xTSB
4. Load 400 μ L into calVials
5. Measure in calScreener for 24 hours at 37°C

RESULTS

In both the face serum and the collagen cream, the calScreener detected microbial activity from a low inoculum of approximately 20 CFU of *P. aeruginosa* and *S. aureus* (Fig. 2).

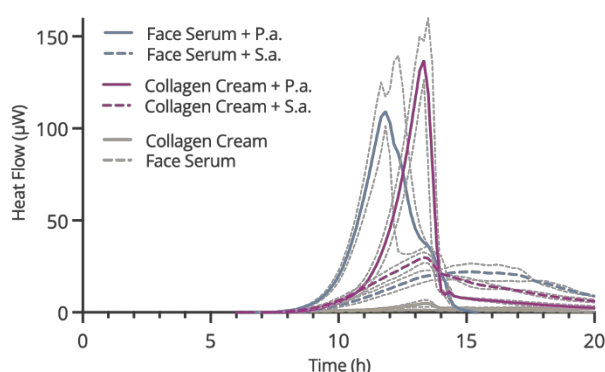


Figure 2. Thermogram of products diluted in TAT and TSB medium with either ~20 CFU of *P. aeruginosa* (P.a.) or *S. aureus* (S.a.), or without bacteria (gray lines).

Neither product matrix showed any notable metabolic activity on their own in the absence of bacterial inoculation, minimizing the risk of false positives and increasing confidence in the results. The calScreener enabled rapid detection of *P. aeruginosa* and *S. aureus* contamination in both the face serum and collagen cream within 8-9 hours, as the signal from the exponentially proliferating microbes crosses the 1 μ W threshold (Fig. 3 and 4).

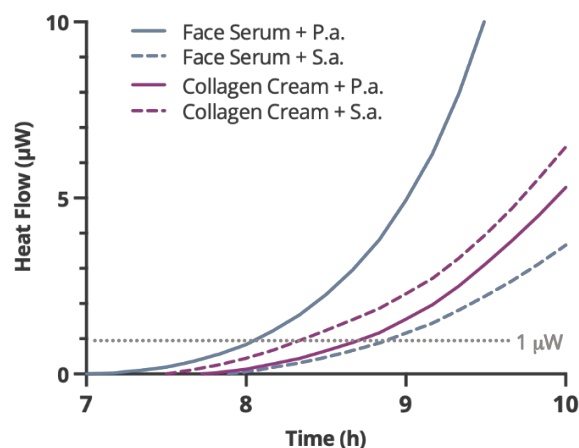


Figure 3. Close-up on thermogram focusing on 7-10 hours of measurement where *P. aeruginosa* (P.a.) and *S. aureus* (S.a.), cross the 1 μ W threshold (sand colored dotted line) as they proliferate in samples with the two products.

CONCLUSION

This study demonstrates that the calScreener can detect low levels of *P. aeruginosa* and *S. aureus* in consumer goods such as face serum and collagen cream, with minimal hands-on effort and no need for plating. Results confirm that microbial activity can be reliably detected within 9 hours using microcalorimetry, enabling same-day detection. This rapid and efficient approach offers a substantial advantage for the cosmetics industry, where bacterial contamination is a recurrent risk. The method's speed and accuracy make it a promising tool for routine quality control, with the potential to reduce product recalls and improve consumer safety.

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Bunnyroo
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