



A Portable Device for Probiotic Counting and Viability Assessment Based on Microfluidic Chip and Image Recognition

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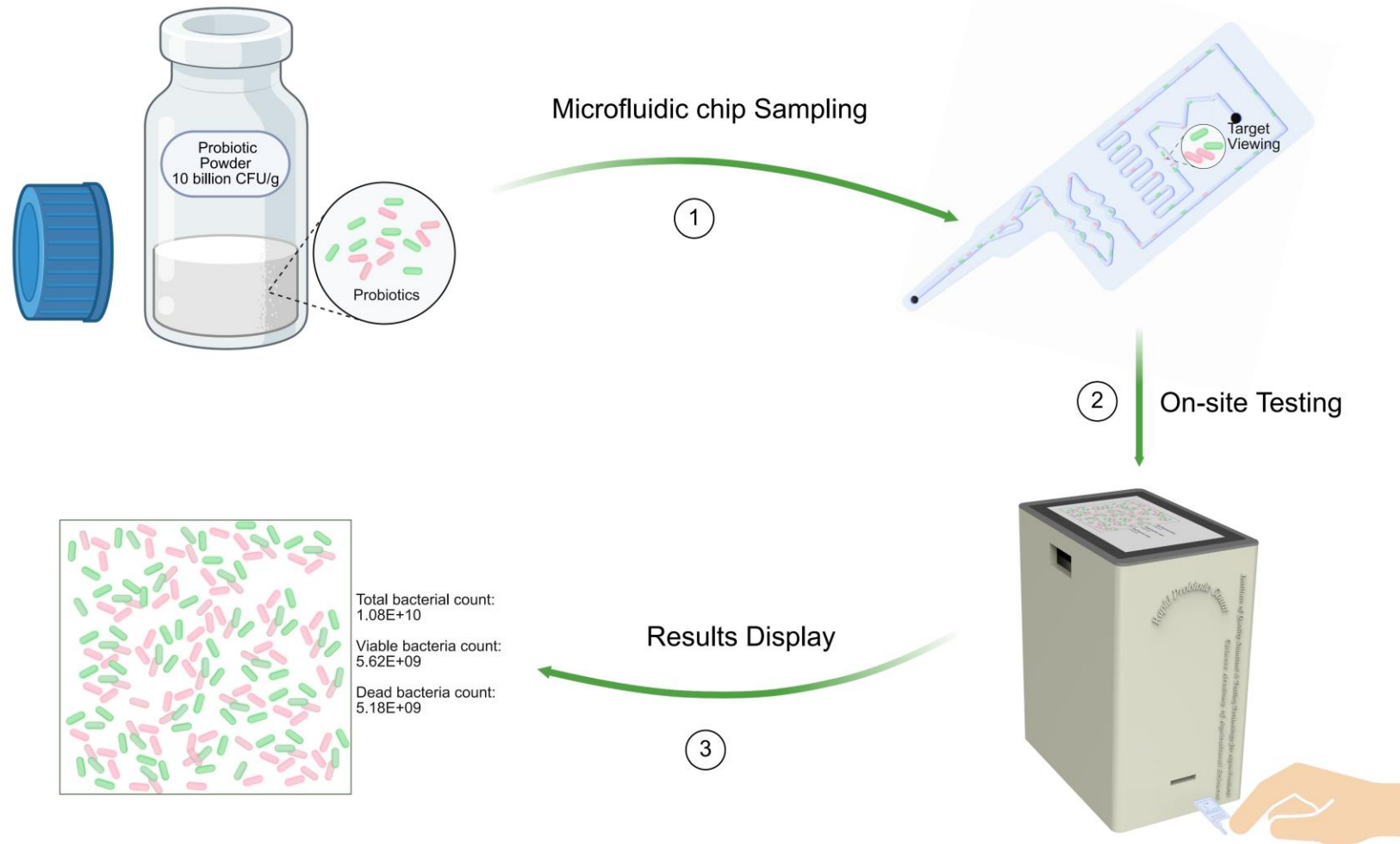


Xiaoyun Sun, Juan Zhang, Jiacy Chen, Longrui Yang, Xiangyi Pang, Xi Chen, Yanjing Chen, et al. 2025.
A Portable Device for Probiotic Counting and Viability Assessment Based on Microfluidic Chip and Image
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Introduction

Development of a Portable Device for Probiotic Counting and Viability Assessment Based on Microfluidic Chip and Image Recognition Technology



- A novel platform was developed for rapid probiotic viability assessment.
- Microfluidic chip and image recognition ensured accurate probiotic quantification.
- Results were delivered in 3 minutes at a low cost of \$2 per test.
- Viable but non-culturable (VBNC) cell detection was achieved, surpassing conventional plate counting.
- A broad quantification range (10^7 – 10^{11} colony-forming units (CFU) mL^{-1}) was demonstrated for practical use.



Portable probiotic quantitative analyzer & Microfluidic chip

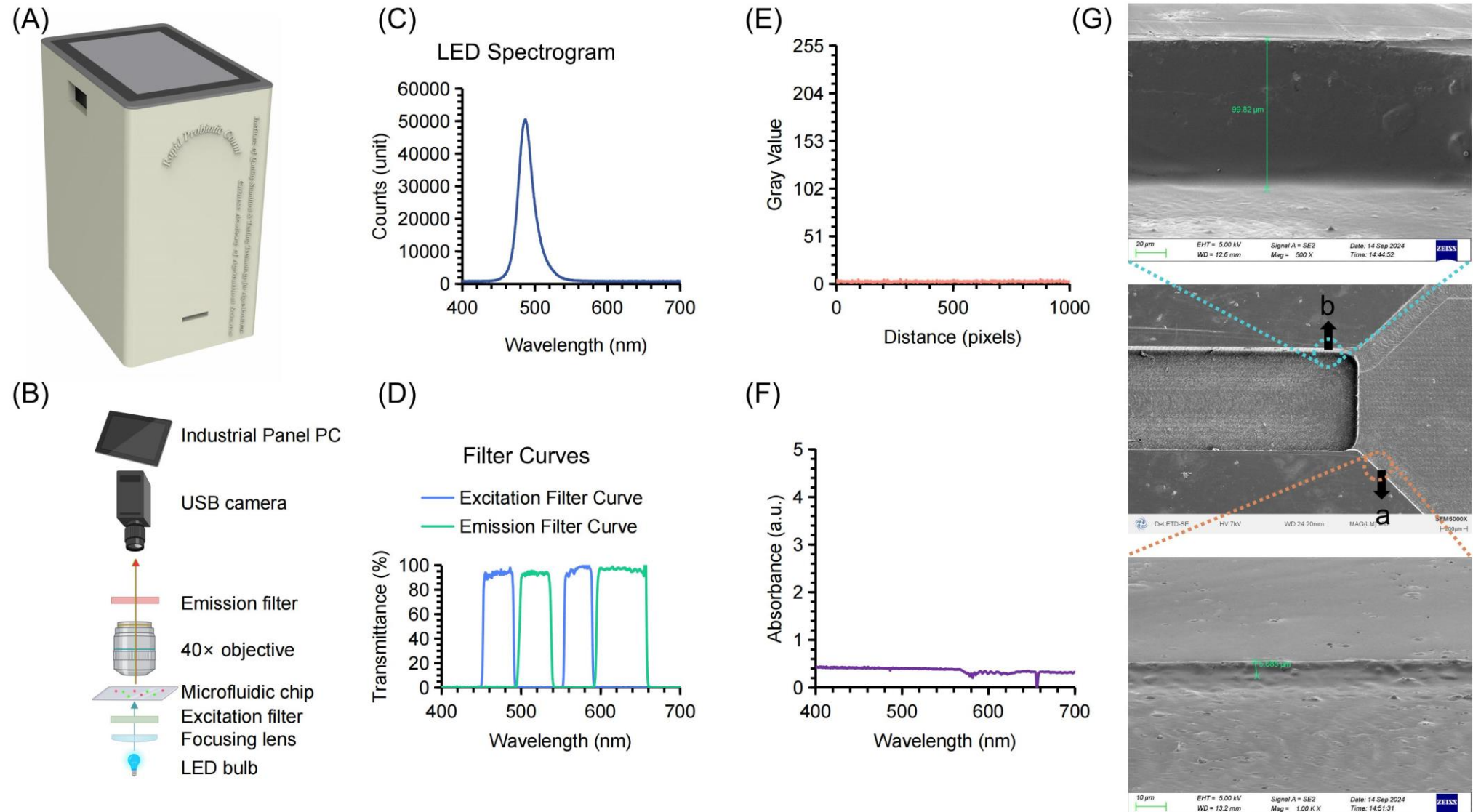
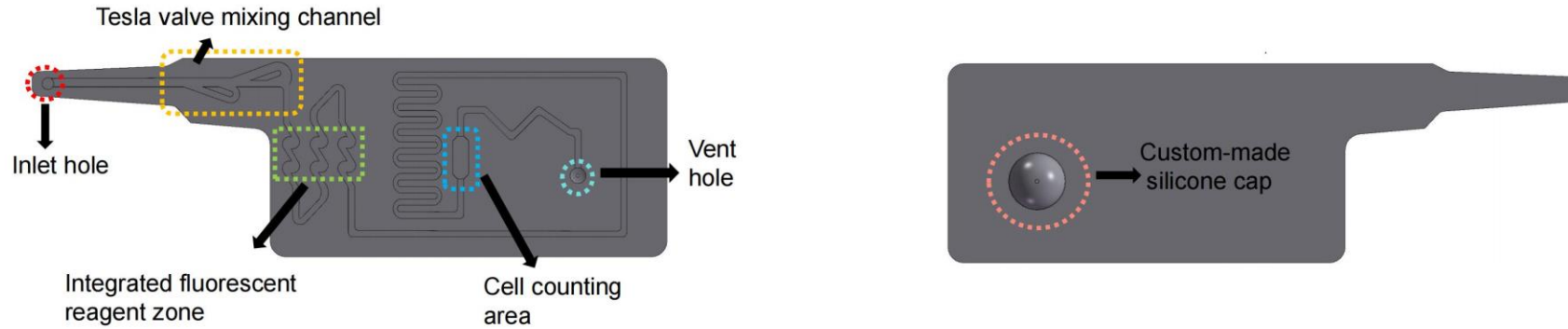


Figure 1 Structural and optical features of the portable probiotic quantitative analyzer and the microfluidic chip



Microfluidic chip and dye concentration optimization

(A)



(B)

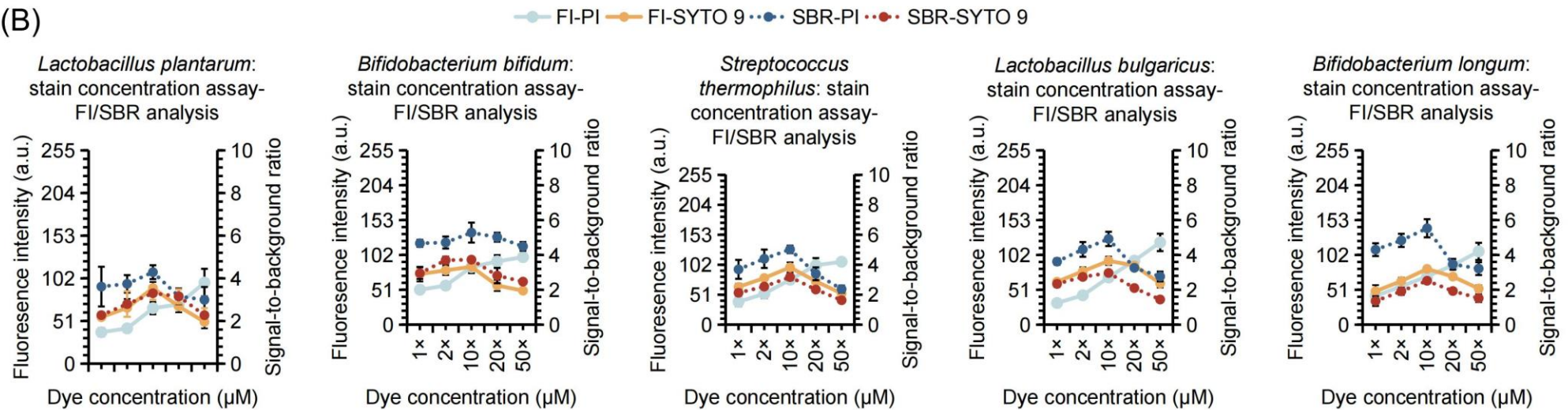


Figure 2 Schematic diagram of the microfluidic chip and dye concentration optimization for probiotic staining



Portable counter characterization

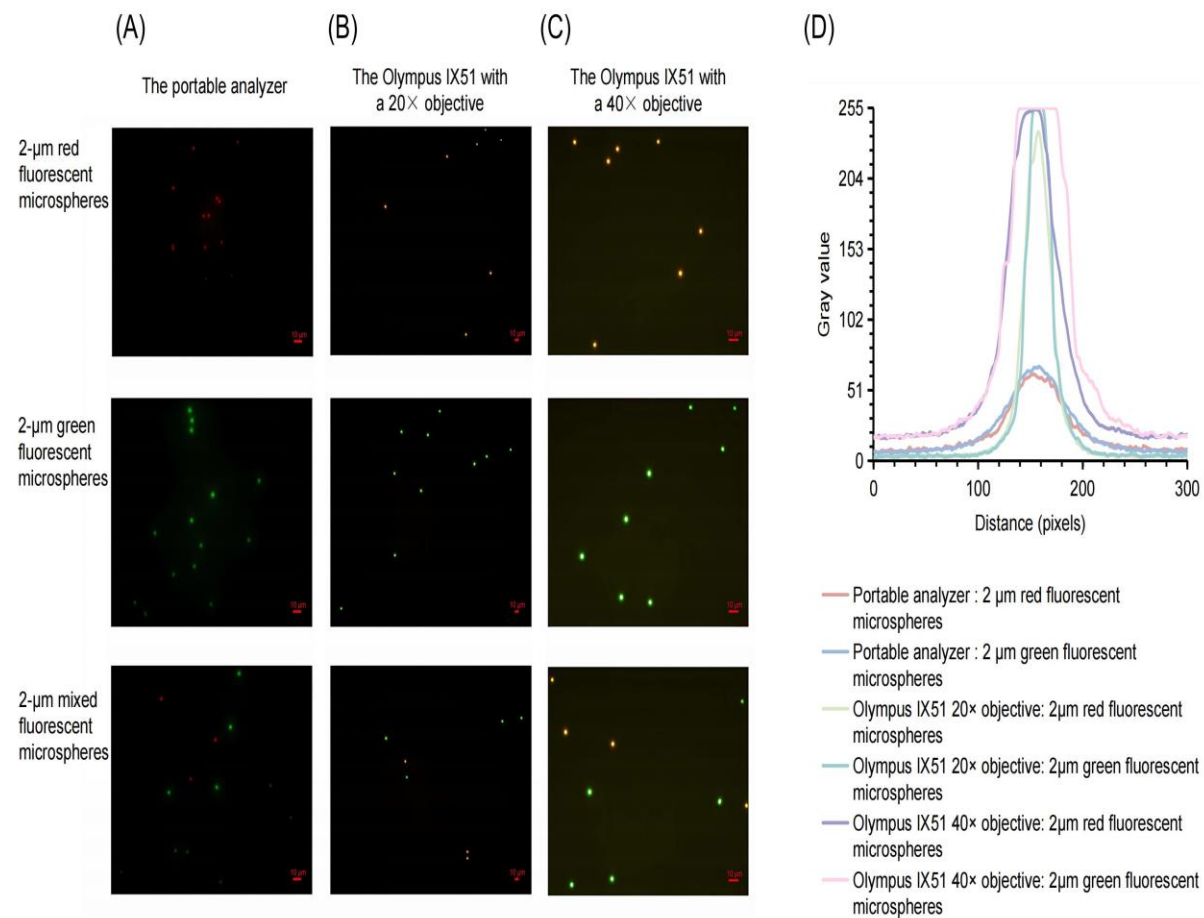


Figure 3 Evaluation of fluorescence imaging performance between the portable analyzer and the commercial Olympus IX51 microscope

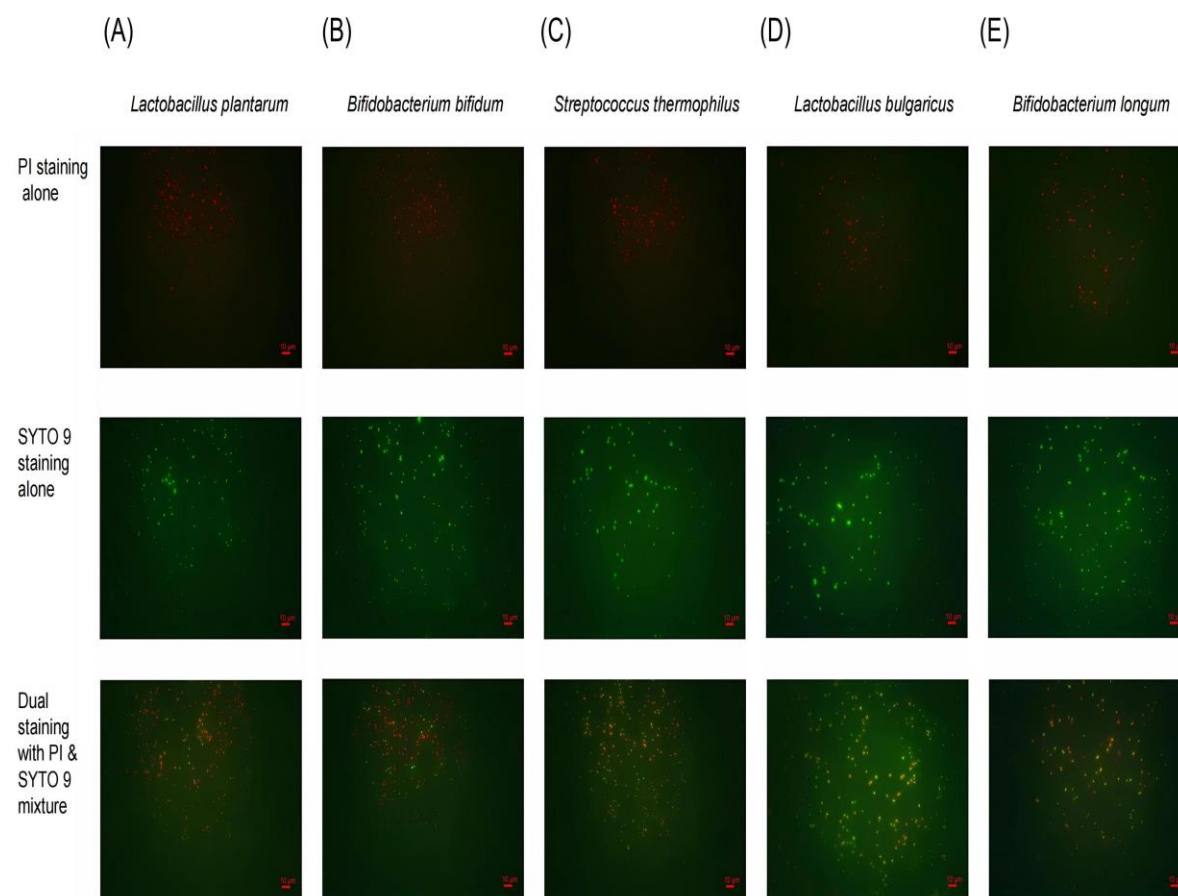



Figure 4 Fluorescence images of probiotic strains



Result



Sample number: LP-6
Time: 2024-08-01 09:47:56
Total bacteria: 2.10×10^9
Viable bacteria: 6.69×10^8
Dead bacteria: 1.45×10^9

Re-analysis Save

History				
Sample number	Time	Total bacteria	Viable bacteria	Dead bacteria
LP-1-1	2024-07-30 17:14:14	1.07e+10	1.05e+10	2.00E+08
LP-1-2	2024-07-30 17:17:29	1.08e+10	1.04e+10	4.00E+08
LP-1-3	2024-07-30 17:21:24	1.07e+10	1.03e+10	4.00E+08
LP-2-1	2024-07-30 17:25:50	1.97e+10	1.88e+10	9.00E+08
LP-2-2	2024-07-30 17:29:22	1.89e+10	1.60e+10	2.90E+09
LP-2-3	2024-07-30 17:33:33	1.60e+10	1.42e+10	1.80E+09
LP-3-1	2024-07-30 17:36:51	3.70e+09	3.31e+09	3.90E+08
LP-3-2	2024-07-30 17:41:46	3.84e+09	2.99e+09	8.50E+08
LP-3-3	2024-07-30 17:48:37	3.85e+09	2.97e+09	8.80E+08
LP-4-1	2024-07-30 17:56:44	1.85e+08	1.57e+08	2.80E+07
LP-4-2	2024-07-30 18:01:51	1.64e+08	1.43e+08	2.10E+07
LP-4-3	2024-07-30 18:07:00	1.50e+08	1.14e+08	3.60E+07
LP-5-1	2024-07-30 18:11:36	7.13e+07	4.28e+07	2.85E+07
LP-5-2	2024-07-30 18:15:01	5.70e+07	3.56e+07	2.14E+07
LP-5-3	2024-07-30 18:18:26	6.41e+07	5.70e+07	7.10E+06
BB-1-1	2024-07-30 19:39:57	3.48e+09	1.75e+09	1.73E+09
BB-1-2	2024-07-30 19:44:21	3.78e+09	1.29e+09	2.49E+09
BB-1-3	2024-07-30 19:48:49	3.88e+09	1.45e+09	2.43E+09
BB-2-1	2024-07-30 19:51:07	7.95e+08	4.35e+08	3.60E+08

kind: Time content: 2024-07-30 look up delete Back

Results display

Figure 5 ProBioCount software interface and algorithm workflow.



Real samples verification

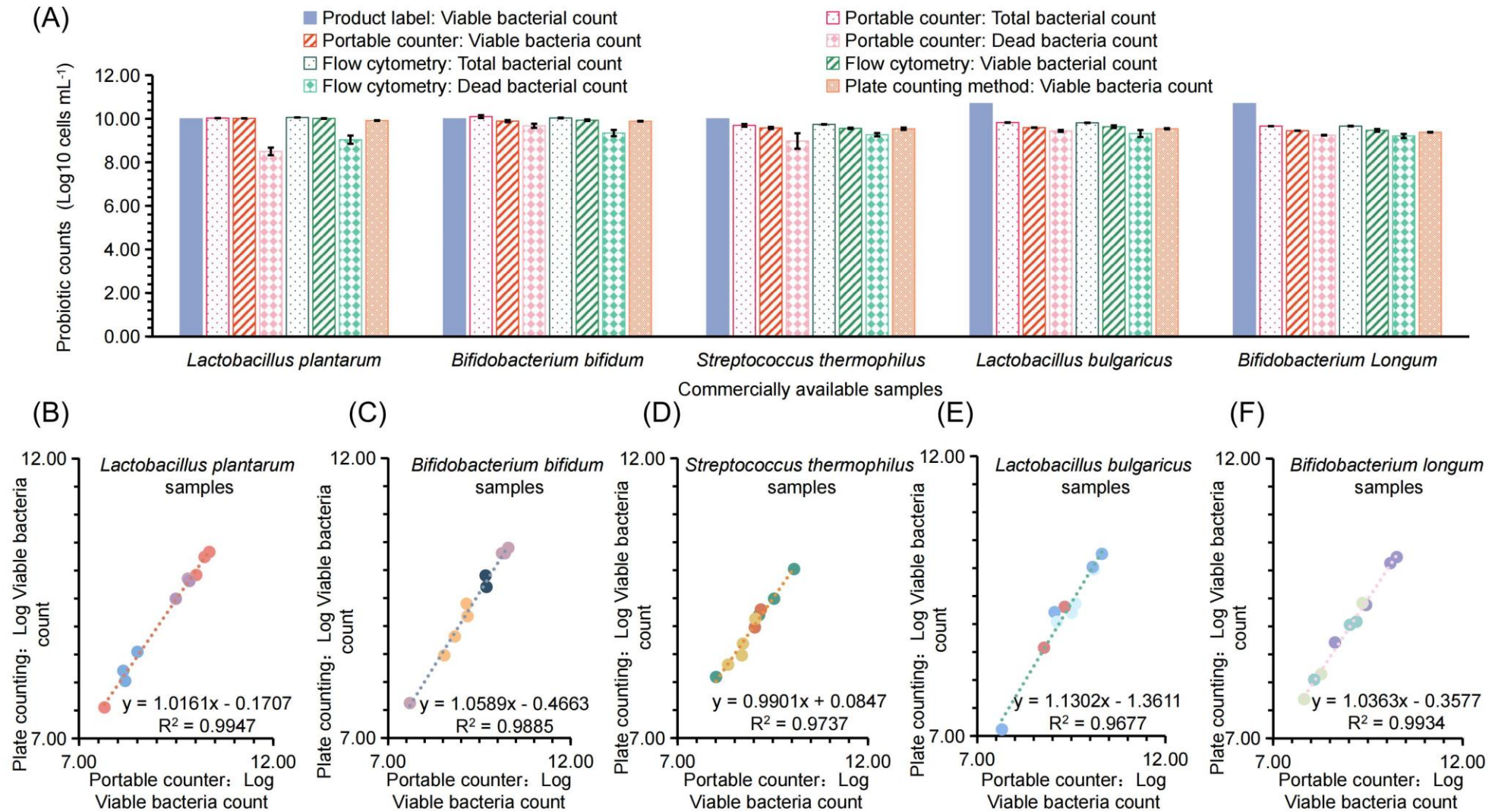


Figure 6 Probiotic counts of commercial samples and comparison with the standard methods



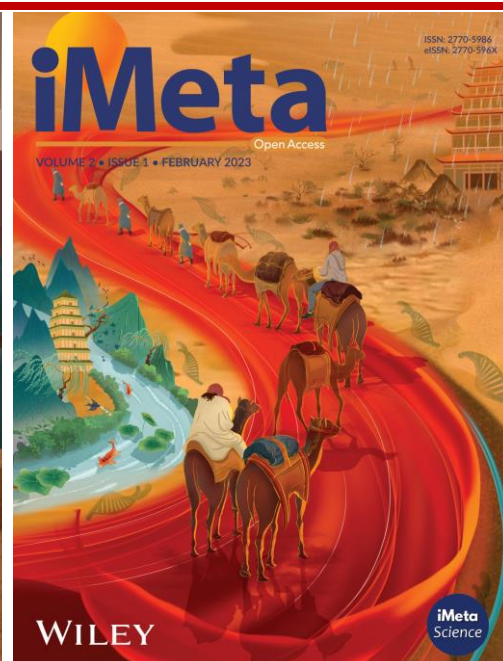
Summary

- ❑ This study developed and validated a portable probiotic quantification system.
- ❑ The system offers advantages such as compact size, low cost, high accuracy, and rapid detection. Comparison with flow cytometry and plate counting confirmed its accuracy and reliability.
- ❑ The platform provides an efficient solution for on-site probiotic viability assessment and holds strong application potential in fields such as food safety, health management, and clinical research.

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