



Storage time effects on the bactericidal activity of plasma treated quats disinfectant-impregnated wipes

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Introduction

An efficient cleaning and disinfection practice plays a crucial role in preventing cross-contamination in nosocomial environment. The binding of quaternary ammonium compounds (QACs) on cellulosic material which may fail the disinfection process hinder the broad use of pre-impregnated disinfecting wipes (ready-to-use disinfectant wipes) in hospitals. Nothing is known about the adsorption and antimicrobial performance of plasma treated wipes. Moreover, ageing of disinfectant-impregnated wipes may affect the products' disinfection performance later in practice but very little research was performed regarding this issue.

Objectives

The purpose of this study is to evaluate the change in terms of adsorption and antimicrobial activity due to the ageing of the disinfecting wipe over storage time with and without atmospheric Double Barrier Dielectric (DBD) plasma pre-treatment. The main questions to be answered are:

- How does the adsorption of active ingredients onto textile substrate change with storage time;
- How does the antimicrobial efficacy vary by time.

The study of the adsorption of QACs in storage is important to ensure hospitals daily workflow and to complement the products' user manual of disinfectant and wipes in the market.

Materials and methods

Plasma-treated and untreated commercial wiping materials of polyester (PET), 55% cellulose/45%PET and 100% cotton were immersed into QACs solution with a certain liquor ratio for 30 min, 3, 7, 15 and 30 days. The absorption and adsorption of QACs onto wiping material were measured by UV spectrophotometer. Standards ASTM E 2149-13a was carried out to assess the antimicrobial efficacy.

The quaternary ammonium salt and wipes used are listed in the Table 1.

Table 1. Test material and variables

Surface Disinfectant: Alkyldimethylbenzylammonium chloride (C₆H₅CH₂N(CH₃)₂RCl (where R=C₈H₁₇ to C₁₈H₃₇))

Textile Substrate	Composition	Structure
Wipe 1	100% polyester	Nonwoven hydroentangled
Wipe 2	55%cellulose/45%polyester	Nonwoven hydroentangled
Wipe 3	100%cotton	1/1 plain weave

Result and discussion

Fourier transform infrared spectroscopy (FTIR)

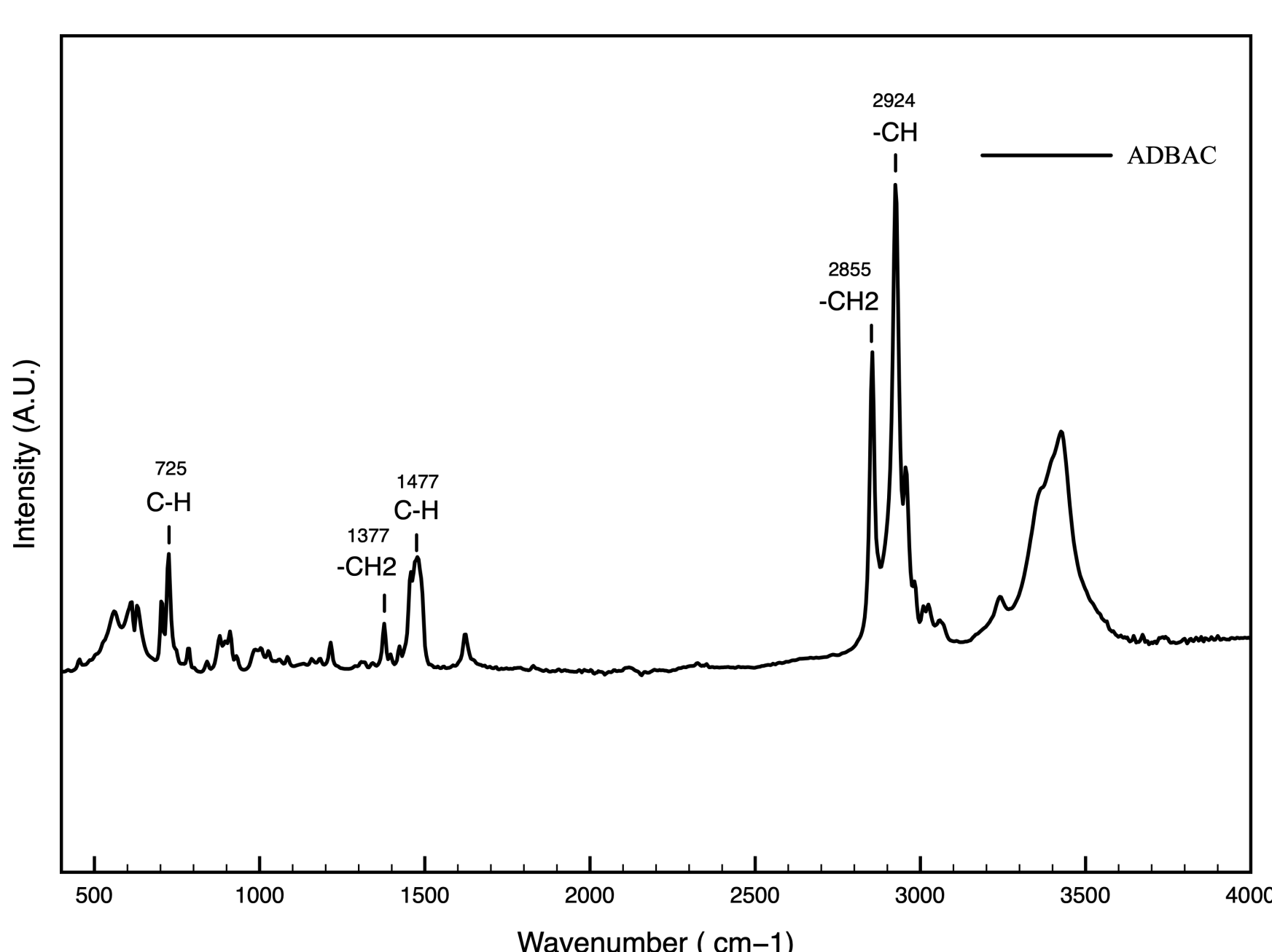


Fig. 1. ATR-FTIR spectrum of ADBAC in the range 400- 4000 cm⁻¹.

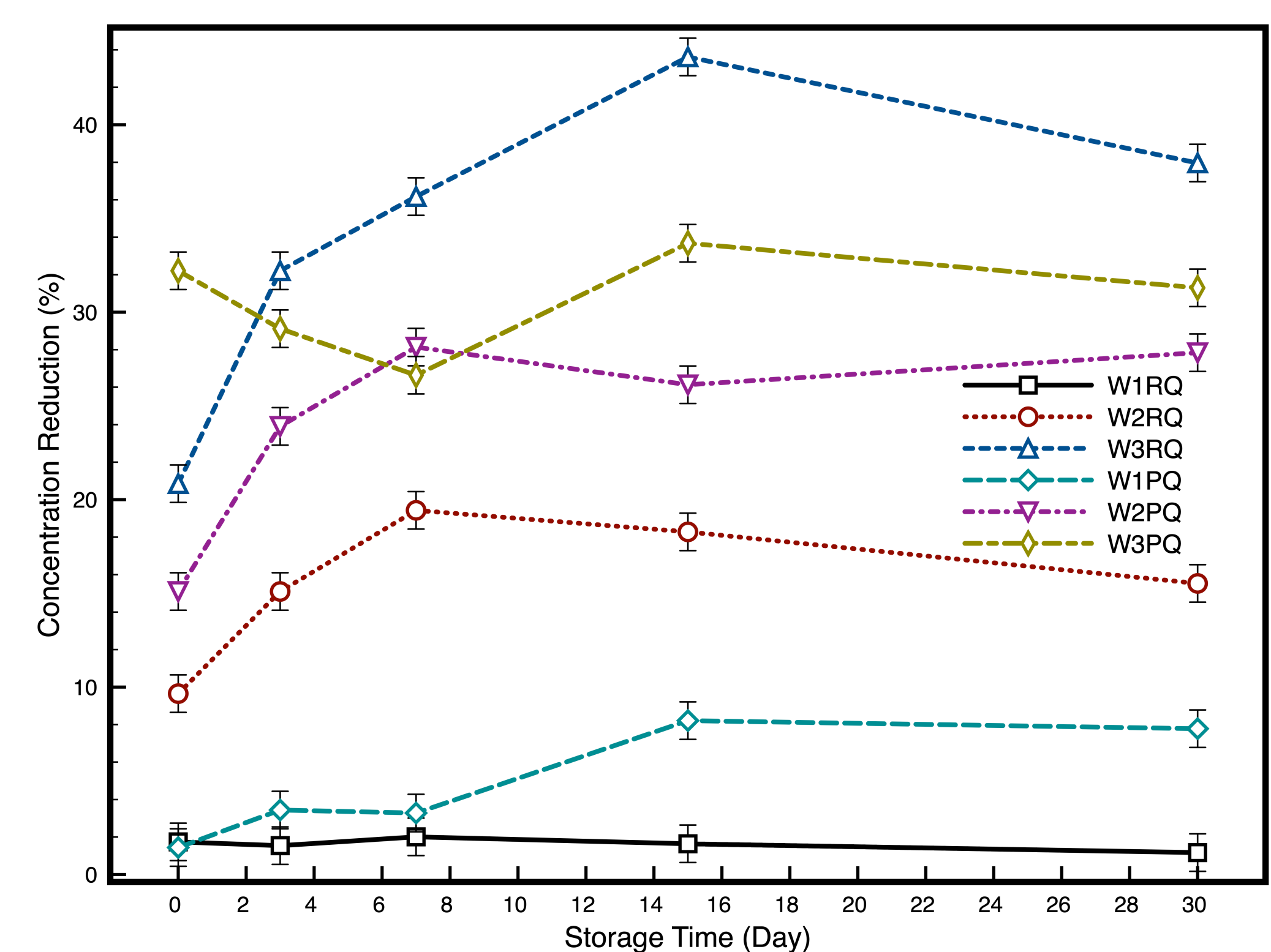


Fig. 2. ADBAC concentration reduction change over storage time.

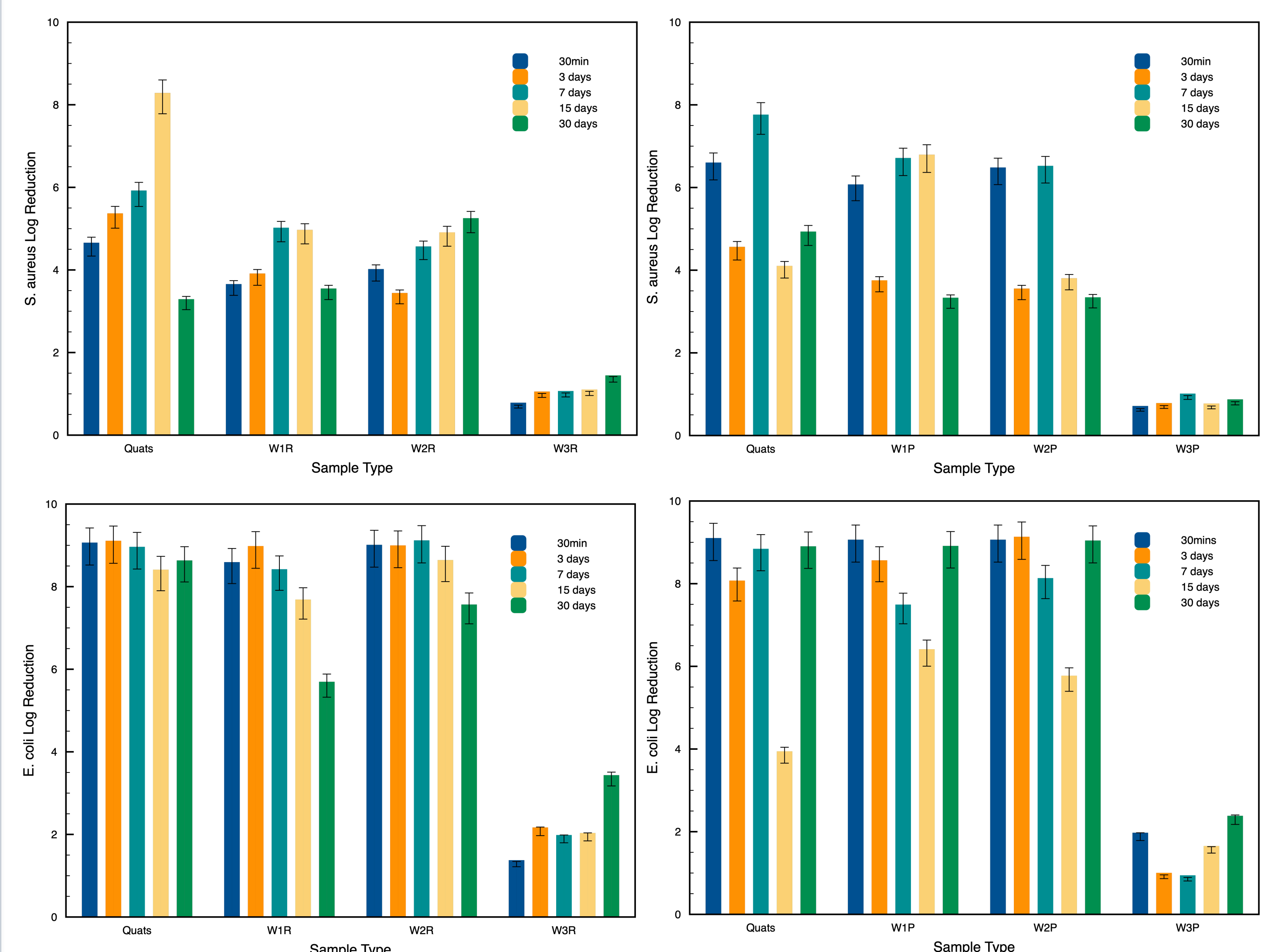


Fig. 3. Antimicrobial efficacy test result (Log reduction) against *S. aureus* and *E. coli* based on test standard ASTM E 2149-13a.

Conclusion

The antimicrobial efficacy result based on standard ASTM E 2149-13a shows 100% cellulose wipe sample failed the antimicrobial test completely (log reduction under 2) due to the adsorption of quats on cellulose. The plasma treatment improves the wiping material's ability against *E. coli* when integrated with quats.

Taking the *E. coli* result from wipe 1 and wipe 2, a slight antimicrobial efficacy decline with the storage time can be observed. Overall, the antimicrobial efficacy did not have a significant change for *S. aureus* over storage time.

Test results shows the adsorption of quats on cellulose completely block the biocidal effect of active ingredients, which is a high risk for infection control. Overall, the quats-impregnated wipes maintain a relative effective antimicrobial performance over storage time.