

Antibacterial effect of a novel material “earth-plus”™ for resistant nosocomial bacteria

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BACKGROUND

With regard to hospital-associated infections, bacterial contamination of fabrics such as doctor's coats, ties, and curtains is problematic and non-negligible. However, it is difficult to disinfect these fabrics.

PURPOSE

The earth-plus™ (Shinshu Ceramics Co. Ltd., Nagano, Japan) is a novel paint, which contains a hydroxyapatite-binding Ag/TiO₂ ceramic composite. The bactericidal effect of cotton / polyester fabric coated with the earth-plus™ was investigated. In addition, the duration of the bactericidal effect was evaluated when the fabric was repeatedly washed.

MATERIALS AND METHODS

(1) Examination of the bactericidal effects

(i) Evaluated objects

#1 cotton / polyester fabrics with the earth-plus™ (e+) coating (4g/m²)

#2 cotton / polyester fabrics without the earth-plus™ (e+) coating

(ii) Bacterial strains

#1 Hospital-acquired methicillin-resistant

Staphylococcus aureus (ATCC BAA-1699)

#2 Community-acquired methicillin-resistant

Staphylococcus aureus (ATCC BAA-1680)

#3 Vancomycin-resistant *Enterococcus faecalis*

(ATCC 51299)

#4 Extend spectrum β-lactamase-producing *Escherichia coli*

(clinical isolate)

#5 Multi-drug resistant *Pseudomonas aeruginosa*

(clinical isolate)

#6 Multi-drug resistant *Acinetobacter* species

(clinical isolate)

(iii) Bactericidal Procedure 1), 2)

#1 According to Japanese Industrial Standards L1902 and ISO 20743

#2 Bacterial suspensions

Density of approximately 1 x 10⁵ CFU/mL

(100μL = 1 x 10⁴ CFU was dropped)

#3 Measurements at time points

0 and 18 hours

#4 Evaluation

- Bacterial solutions were extracted from each objects by shaking.
- The plate-colony count method is performed.
- Colonies were counted after incubation for 24 hours at 37 degree.
- The examination was performed three times.

(2) Examination of earthplus with various washing times

(i) Evaluated objects: The same objects (1)-(i)

(ii) Bacterial strains: The same strains (1)-(ii)

(iii) Washing Procedure

#1 Washing method

- Hot water of 80 degrees was used
- Washing times are 10, 50, 100, and 150

#2 Bacterial suspensions

After washing, 1 x 10⁴ CFU was dropped on the objects and incubated at 37 degrees for 18 hours

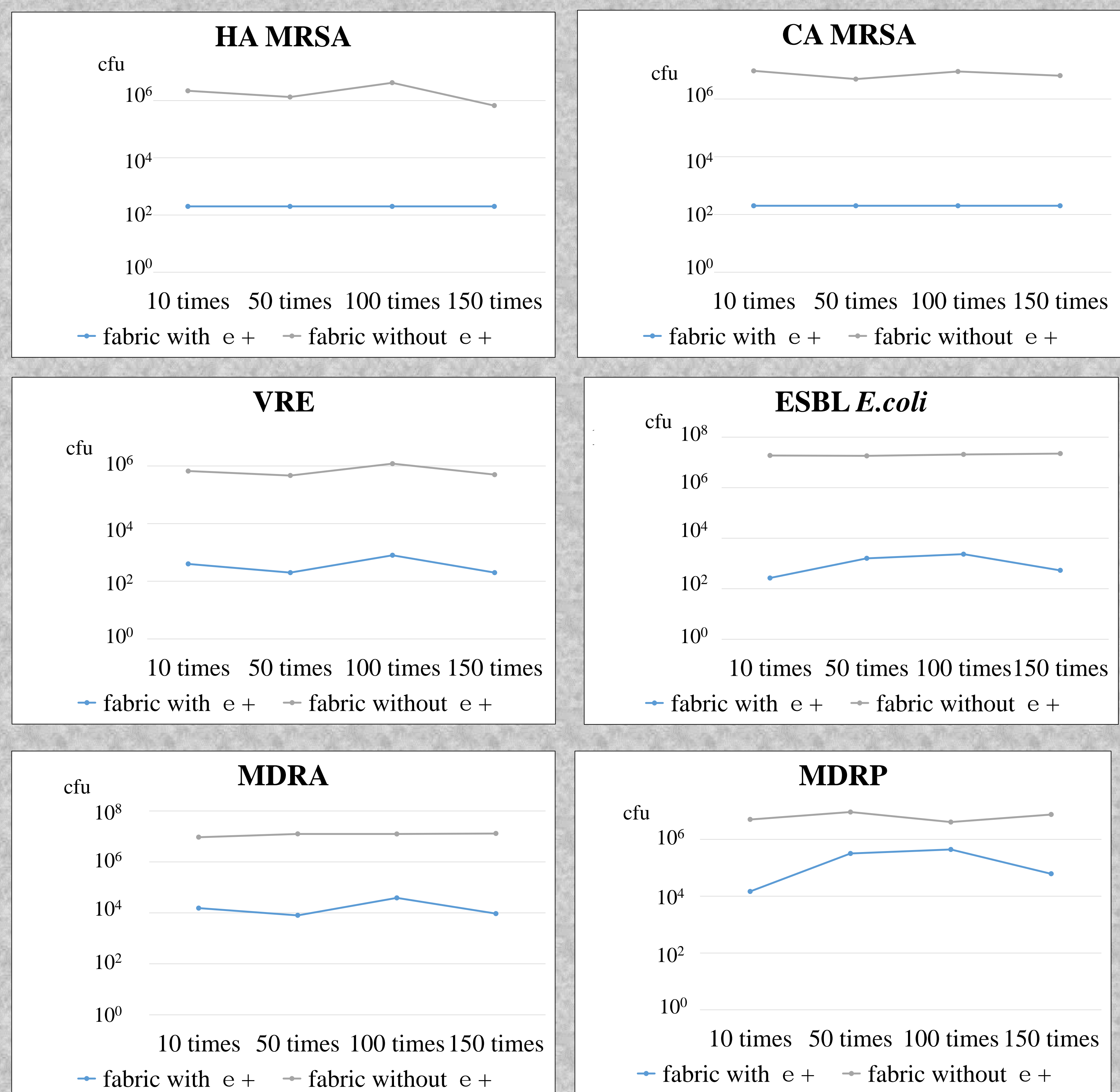
#3 Evaluation: Same as (1)-(iii)-#4

RESULTS

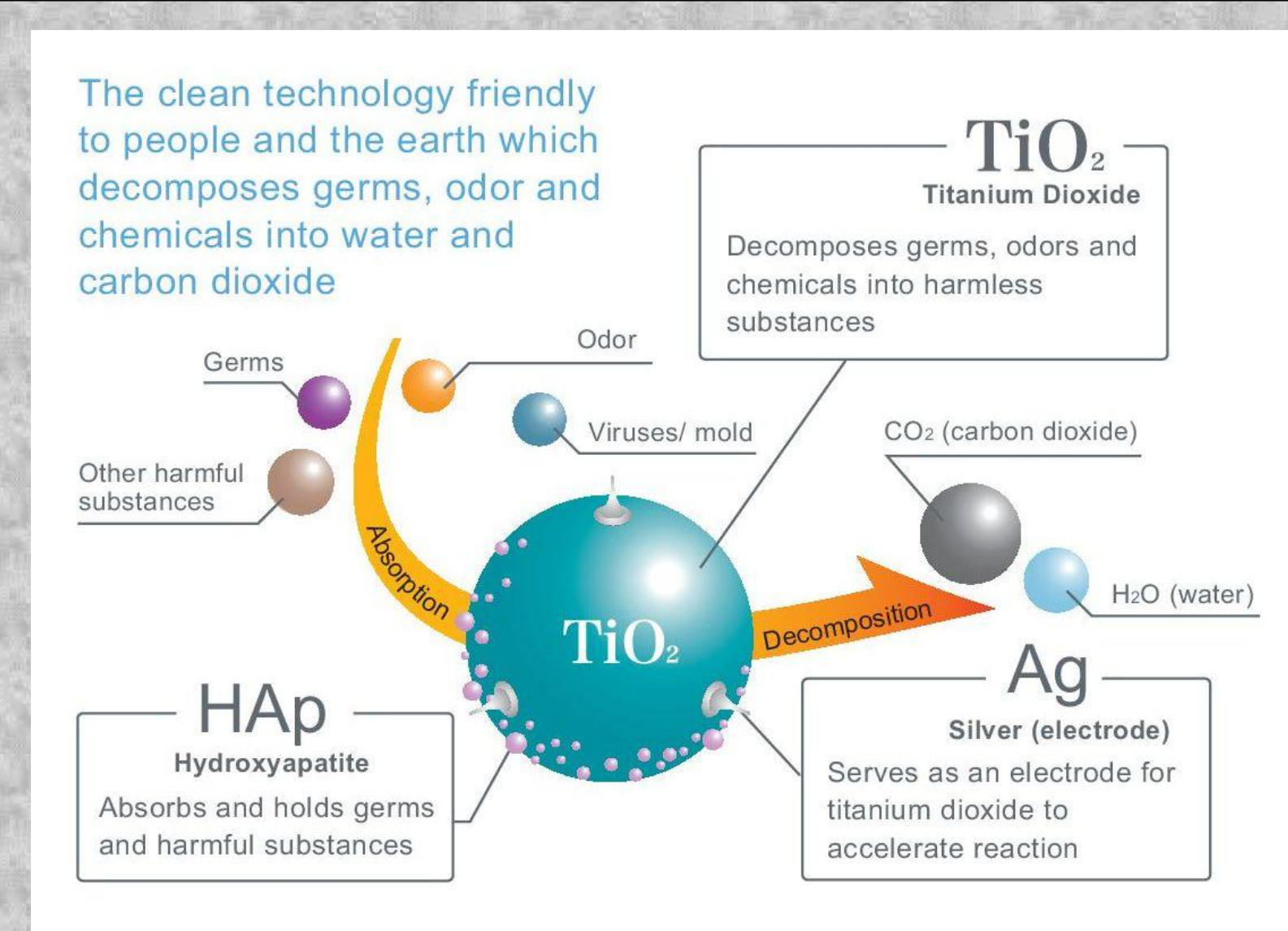
Table : Bactericidal effects for fabric with or without e+

Bacterial strains	objects	Incubation time		Inhibition rate of growth
		0h	18h	
HA-MRSA (ATCC BAA-1699)	fabric without e+	4.3	6.7	99.99
	fabric with e+	4.4	2.3	
CA-MRSA (ATCC BAA-1680)	fabric without e+	4.7	6.9	99.99
	fabric with e+	4.7	3.2	
VRE (ATCC 51299)	fabric without e+	4.7	5.9	99.92
	fabric with e+	4.1	2.7	
ESBL <i>E. coli</i> (clinical isolate)	fabric without e+	2.4	6.3	99.99
	fabric with e+	3.3	<1.3	
MDRP (clinical isolate)	fabric without e+	2.4	6.3	99.99
	fabric with e+	3.3	<1.3	
MDRA (clinical isolate)	fabric without e+	4.4	5.9	99.99
	fabric with e+	4.3	<1.3	

Figure ; Bactericidal effect for 10, 50, 100, and 150 washing times



FUNCTIONS OF “earth-plus”™



- Non-elution feature
- Ceramics compound material
- The earthplus does not elute in water due to being a ceramics compound material, therefore, it is a safe, low burden to environments material.

CONCLUSIONS

The earth-plus™ can be used to coat various materials. Cotton / polyester coated with the earth-plus could contribute to a decrease of cross-contamination by problematic drug-resistant bacteria that cause hospital-associated infections due to its bactericidal effect and long-lasting antibacterial activity.

BIBLIOGRAPHY

1. Japanese Industrial Standards Committee. JIS L1902. Available from: <http://www.jisc.go.jp/index.html>. Accessed August 26, 2011.
2. Swenson LM, Hindler JF, Jorgensen JH. Assessment of Bactericidal Activity by the Time-Kill Method. In Manual of Clinical Microbiology, 8th ed. Washington, DC: American Society of Microbiology; 2003.