BioCote®

Application note: A12-001A

BioCote® treatment reduces contamination of laboratory equipment

Introduction

Safety in the laboratory is based on the principles of good laboratory practice (GLP) (1). GLP is modified according to the type of work carried out by different laboratories. For example, microbiology laboratories operate according to the principles of good microbiology practice (GMP). The principles of GMP apply irrespective of the nature of the microorganism being worked on and its containment level.

Maintaining a safe working environment relies on a number of GMP procedures. For example, by ensuring that if an organism is released from its container, either by accident or intentionally, it remains in the laboratory and presents minimal hazard to laboratory workers. GMP is also required to prevent cross-contamination of different microorganisms.

Despite compliance to these safety frameworks, there are various reports of organisms being detected in the laboratory environment that pose an infection hazard to workers (2-4). In some instances, good practice can break down to the point that these threats result in laboratory acquired infection (5-10).

Another consequence of microorganisms present in the laboratory environment is contamination of experiments and tests. This can have serious consequences in diagnostic laboratories where contamination has lead to false positive results (11-13).

Methods of reducing the number of microorganisms in the laboratory environment are important to limit the spread and reduce the risk of microbial contamination. This is usually carried out by disinfection of laboratory equipment and surfaces. An additional option is to use permanent antimicrobial surfaces in the laboratory, particularly the surfaces and controls of instruments at risk of contamination.

Technological advances in the manufacture of materials and coatings allow inorganic silver ions to be incorporated into laboratory instruments at the time of manufacture. Silver is known to be actively antimicrobial against a wide range of bacteria and fungi (see Figure 1). Once the silver ions have been incorporated, they are permanently present at or near the surface of the instrument. This means that protection against instrument contamination, cross-contamination of laboratory work and infection of workers is continuous. Therefore laboratory instruments that are in physical contact with reagents, test and experimental material and are subject to repeated hand contact by many users, are ideal candidates for manufacture with silver antimicrobial surfaces.

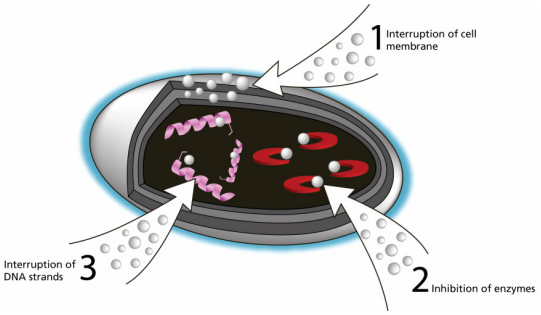

Figure 1: The antimicrobial effects of silver are thought to occur by three mechanisms:
1. Interruption of cellular membranes: When the silver ions reach the surface of the microbe (or cell), they bind to the cell surface and disrupt cellular membrane function.
2. Inhibition of enzymes: Once inside the cell, silver ions target protein thiol groups and inhibit critical enzymes. Many of these enzymes are involved in the production of cellular energy, so once this energy source is removed the cell cannot maintain osmotic pressure and necessary substrates will begin to leak out of the cell. When this occurs the microbe will quickly die.
3. DNA interruption: It is thought that silver prevents bonds between the two strands of the double-stranded helix from separating, thereby causing the inhibition of transcription and DNA replication.

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We describe here an investigation carried out in an active university research laboratory demonstrating the ability of silver ion (BioCote®) treatment to reduce levels of bacterial contamination found on the surfaces of treated Stuart equipment.

Methods

The study was performed in a research laboratory at the University of Birmingham, UK, conducting work for Cancer Research UK (14). BioCote®-treated instruments from the Stuart laboratory equipment range (see Table 1) and untreated equipment were included in the study. All the instruments included in the study had been routinely used in the laboratory for approximately 18 months prior to the study commencing.

Sterile cotton-tipped Transtube swabs containing a neutralising buffer (MW & E, Corsham, UK) were used to collect triplicate samples from the sample points of each instrument included in the study.

Swabs were collected once every two weeks for a period of two months. Swabs were inoculated on plate count agar and incubated aerobically at 30ºC for 48 hrs to determine the number of viable bacteria. Total Viable Counts (TVC) were obtained by colony counts and expressed as Colony Forming Units (CFUs). Mean TVCs were calculated from the total number of colonies isolated from each product sampled.

Instrument	Description	Use	Component sampled
Gyro Rocker (Stuart SSL3)	BioCote® protected. 3D gyratory motion rocker.	Typically low foaming agitation and staining procedures	Touch pad/control dials and casing
Hotplate Stirrer #1 (Stuart CB162)	BioCote® protected. Ceramic-topped magnetic stirrer	General purpose heating/stirring	Control dials and casing
Rotator (Stuart SB2)	BioCote® protected. Fixed speed, tube rotator	Mixing/maintaining suspensions	Control switch and casing
Mixer (Stuart SA8)	BioCote® protected. Variable speed vortex mixer	Gentle (200rpm) to vigorous (2500rpm) vortex mixing	Touch pad/control dials and casing
Block Heater (Stuart SBH130DC)	BioCote® protected. Dual control aluminium blocks	Heating up to 200^{0}C	Touch pad and casing
Hotplate Stirrer #2 (Stuart CB162)	BioCote® protected. Ceramic-topped magnetic stirrer	Heating stirring up to 15 litre at 1500rpm	Control dials and casing
Biophotometer	Untreated	Bench top UV/Vis photometer	Touch pad and casing
Centrifuge (#1)	Untreated	General bench top centrifugation	Control panel and casing
Centrifuge (#2)	Untreated	General bench top centrifugation	Control panel and casing
Centrifuge (#3)	Untreated	General bench top centrifugation	Control panel and casing
Laboratory equipment	Untreated. Handles of fridge and incubator	General laboratory equipment for incubation and storage of tests and reagents	Handles
Power pack	Untreated	Power supply to bench top gel electrophoresis kit	Touch pad and casing

Table 1: BioCote®-treated and untreated laboratory equipment evaluated in the study.

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Results

The instruments tested in this study were regularly subjected to hand contact by several laboratory workers and were in close physical contact with test material and reagents. The results, shown in Table 2, demonstrate that the mean TVCs found on the BioCote®-treated Stuart equipment was reduced by more than 96% compared to untreated equipment tested in the same laboratory.

Equipment (see Table 1)	Number of swabs collected during study	Mean CFU/swab
BioCote® treated Stuart Instruments	144	13
Untreated laboratory equipment	168	390
Mean reduction of TVCs on BioCote® treated Stuart Instruments		96.7%

Table 2: Comparison of mean CFU counts from BioCote®-treated and untreated laboratory equipment

The majority of swabs (85%) collected from BioCote®-treated Stuart equipment showed counts of less than 10 CFUs (see Figure 2). In comparison, only 51% of swabs collected from untreated equipment yielded counts of <10 CFUs.

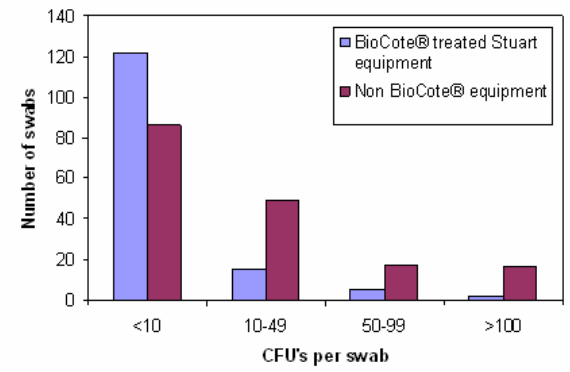

Figure 2: Distribution of quantities of total viable bacteria isolated from BioCote®-treated and untreated laboratory equipment

Conclusions

Good laboratory practice is essential in maintaining health and safety in the laboratory environment. This can be achieved in a number of ways including microbial decontamination, which is important in reducing the risks of laboratory acquired infection and contamination of laboratory work. Technologies such as BioCote® that contribute to reducing the level of microbial contamination of surfaces and equipment in the laboratory can therefore play an important role in managing GLP.

This study has demonstrated that levels of microbial contamination found on BioCote®-treated Stuart laboratory equipment were reduced by over 96% compared to untreated instruments used in the same environment.

In environments such as laboratories and hospitals where acquired infection is a high risk, the role of cleaning and decontamination is central to the prevention and control of this problem. When built into laboratory or hospital equipment, antimicrobial technology such as BioCote® will continually help to decontaminate surfaces. BioCote®-treated Stuart products therefore have a role to play in producing working laboratory environments that comply with the highest standards of health and safety.

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