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Adherence and Persistence of Air Microbes on Computer Silicon Chips

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ABSTRACT

Microorganisms fall continuously on the surface of silicon chips in computers, without showing any significant damage of their surfaces. In this experiment microorganisms collected from air, were allowed to adhere on the surfaces of silicon chips which was compared to a similar situation on plastic surfaces. After a short incubation it was found that microbial adherence on the surface of silicon chips was much less than that on the plastic surfaces.
Keywords: silicon chips, microbes, persistence

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INTRODUCTION

Identification and analysis of microbial inhibitory agents are worthwhile endeavors in an era when few new classes of effective antimicrobials have been developed. The studies using metallic surfaces to diminish microbial contaminations has been less evident since the earliest recorded history. Antibacterial activities of silicon are largely unknown, although few studies indirectly indicated that there are possibilities of its antibacterial action. In a recent study a bioinspired hybrid silica- protein material showed antibacterial activity against *E. coli* by iron uptake [1]. Similarly in 2012, Wang et al observed antibacterial activity of $Ca_3SiO_5/CaCl_2$ composite cement for dental applications [2]. Privett et al demonstrated decreased adhesion of *Pseudomonas aeruginosa* and *Staphylococcus aureus* on surfaces of silica colloids, fluoroalkoxysilane, and backbone silane [3]. Dental plaque formation and bacterial adherence were significantly less when composite resin with glass isomer was used as filler particles in comparison to the contemporary commercial composite resin [4]. Some clay minerals were also capable of some antibacterial activities [5]. Bacterocins, pediocin, brevicin, piscicolin were desorbed in diatomite calcium silicate [6]. Adsorption of nisin onto silica surfaces was found to suppress colonization of *Listeria monocytogenes* [7]. Nisin is an antimicrobial peptide proven to be an effective inhibitor of gram-positive bacteria.

Ideal metallic surfaces not only resist adhesion of fouling agents (i.e., microorganisms), but allow for easy removal of contamination that may occur. “Self-cleaning” surfaces that exist in nature include lotus leaves and water strider legs. These surfaces are known as super hydrophobic, and have static water contact angles >150° [8, 9]. Synthetic super hydrophobic surfaces are prepared involving surface modification via nano particles, photolithography, mesoporous polymers or surface etching resulting in nanoscale surface roughness, sometimes in conjunction with additional chemical modifications to reduce surface energy [8, 10]. In this study we have explored bacterial survival or adhesion on a similar surface which is commonly used as silicon chips in computers.

MATERIALS AND METHODS

Collection of Air Microorganisms

Petridishes containing blood agar medium were exposed for one hour in ambient temperature and under indoor static air current. After the exposure the plates were incubated overnight and common microbial colonies were recorded. Following that the most common microorganisms were subcultured, stocked by standard procedures and were used in this experiment.

Collection and Preparation of the Silicon Chips for the Experiment

Silicon chips were collected from different computers which were not used and then they were thoroughly cleaned and washed in sterile distilled water, dried and exposed under UV radiation for one hour before the experiment.

Collection and Preparation of the Plastics for the Experiment

Plastic petridishes were taken from the laboratory and then they were thoroughly cleaned and washed in sterile distilled water, dried and exposed under UV radiation for one hour before the experiment.

Preparation of the Bacterial Suspension

Initially a bacterial suspension was made in sterile peptone water which was equivalent to 0.5 MacFarland solution containing the most commonly isolated microorganisms from air. Then it was further serially diluted 1:10 each time. This suspension was prepared just before the experiment.

Application of Bacterial Suspensions on the Surfaces

The same bacterial suspension containing the most common microorganisms isolated from the air were mixed uniformly in a vortex and then centrifuged at 1200 rpm in a sterile capped centrifuge tube for one minutes to settle ant bacterial clump present in the suspension and then with the help of sterile cotton swabs dipped smoothly and kept for one minute in the suspension were rubbed gently on the surface of silicon chips and plastic surfaces. Following this the chips and the plastic were kept in the incubator at 37^{o}C for 4 hours in sealed sterile containers.

Culture of Swabs Taken From the Surfaces

After incubation swabs were taken from the inoculated surfaces and cultures were made on blood agar media which were incubated overnight at 37^{o}C and the colony forming units on the incubated agar plates were noted.

RESULTS

Table 1 showing bacterial colony forming units on different surfaces.

Surfaces Plastic surfaces(controls)	Colony forming units (cfu)	Mean Value (Mcfu)
P1	24	26.66
P2	26	
P3	30	
Silicon chip surfaces(Test)		
S1	10	10.66
S2	4	
S3	18	

P-Plastic surfaces; S-Silicon surfaces

The microorganisms which were predominantly isolated from the air were *Staphylococcus* species (coagulase negative staphylococcus) and *Micrococcus* spp. The colony forming units of these bacteria recovered from the inoculated silicon and plastic surfaces are given in the Table 1.

DISCUSSION

In this study air microorganisms were isolated by plate exposure method and it was found that common isolated organisms were Micrococcus spp. and Staphylococcus spp. These two bacteria commonly present on the surface of dust particles and thus they could survive on such particles although air itself is a bad medium for survival of microorganisms. Dust also contains silica, thus there is also a possibility that silica present in dust particles may also have some chemico-biological effect on them. These two microorganisms were applied on silicon chips and after incubation it was found that air microorganisms – both Staphylococci and Micrococci were significantly less on surfaces of silicon chips when compared to their persistence on plastic surfaces. Thus a super-hydrophobic like action appears to be present also on the surfaces of the silicon chips.

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