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ANTIBACTERIAL PROPERTIES OF SNAKESKIN INSPIRED PDMS SURFACES LAYERED WITH POLY-DL-LACTIC ACID NANOSHEET

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ABSTRACT

The increment of sterilization resistant bacteria minimizes the effectiveness of disinfectants which leads researchers into studying other means in minimizing bacterial contamination on surfaces. Hence, this study plans to investigate surfaces with the ability to discourage bacterial adhesion and reduces the need for frequent sterilization. This study tested the feasibility of applying snakeskin inspired microstructures onto a polydimethylsiloxane (PDMS) surface to reduce bacterial adhesion and increase its antibacterial properties. In theory, the microstructure of snakeskin is smaller or about the same size as a bacterium making it unfeasible for bacterial adhesion. The embedded-elastomeric stamping method was used for the biomimicry of snakeskin onto PDMS surfaces. The replicated snakeskin and controlled (no microstructure) PDMS samples were layered with Poly-DL-lactic acid (PDLLA) nanosheet of different thickness. Then, the morphology of the surfaces was observed using a scanning electron microscope. The surface of the samples was tested with Staphylococcus aureus and Bacillus with compliance of the ISO 22196 standard to evaluate the antimicrobial activity. Our results revealed, surfaces with snakeskin microstructures displayed a 16% reduction in bacterial adhesion compared to flat PDMS. Whereas the presence of nanosheet does not significantly affect the adhesion of bacteria on the replicated snakeskin. These findings suggest that surfaces with the presence of snakeskin microstructures possess antibacterial property.

Keywords: Snakeskin, antibacterial, nanosheet, PDMS, biomimicry

NOMENCLATURE

AFM	Atomic force microscopy
CLSM	Confocal laser scanning microscopy
ISO	International Organization for Standardization
NA	Nutrient Agar
NB	Nutrient Broth
OD	Optical density
PDLLA	Poly (L-lactic acid)
PDMS	Polydimethylsiloxane
PEES	PDMS embedded-elastomeric stamping
PES	PDMS elastomeric stamping
PET	Polyethylene Terephthalate
PP	Polypropylene
SA	Staphylococcus aureus
SEM	Scanning Electron Microscope

1. INTRODUCTION

COVID-19 is a highly contagious viral illness caused by the SARS-CoV-2 virus [1,2]. The pandemic has affected millions of people worldwide, causing severe respiratory illness, hospitalizations, and deaths [1]. The impacts of COVID-19 have been felt globally, with disruptions to economies, businesses, and everyday life. It was found that the pandemic have profoundly impacted the socio-economics especially students from vulnerable economical background where they suffer increased stress levels [2]. To mitigate the spread of viruses and bacteria, health sectors have taken extra measures, such as implementing quarantine and isolation protocols, increasing testing capacity, promoting social distancing, and encouraging vaccination [3].

Cross contamination is one of the main route of transmission for the COVID-19 as described by the World Health Organization (WHO). Therefore, sanitization of high touch surfaces is a proactive and planned strategy to stop SARS-CoV2 from spreading [4]. Routine sanitization of surfaces helps to