Pakistan Journal of Biological Sciences 18 (2): 67-73, 2015
ISSN 1028-8880

ansinet
Asian Network for Scientific Information

RESEARCH ARTICLE OPEN ACCESS

DOI: 10.3923/pjbs.2015.67.73

Prevention of Bacterial Biofilms Formation on Urinary Catheter by Selected Plant Extracts

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ARTICLE INFO
Article History:
Received: November 13, 2014
Accepted: January 15, 2015

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ABSTRACT
In this study, we investigated the feasibility of using *Psidium guajava*, *Mangifera indica* and *Ocimum gratissimum* leaf extracts in preventing *Escherichia coli* biofilm formation. The plants extractions were done with methanol under cold extraction. The various concentrations 5.0, 10.0 and 20.0 mg mL^{-1} were used to coat 63 catheters under mild heat from water bath. Biofilm formation on the catheter was induced using cultures of *E. coli*. Biofilm formation was evaluated using aerobic plate count and turbidity at 600 nm. From the obtained results, *Psidium guajava*, *Mangifera indica* and *Ocimum gratissimum* delayed the onset of biofilm formation for a week. *Ocimum gratissimum* coated catheter had the highest inhibitory effect at 5.0, 10.0 and 20.0 mg mL^{-1} with bacterial count ranging from 2.2×10^5-7.0×10^4 and 5.7×10^5-3.7×10^5 for 120 and 128 h, respectively. The *Psidium guajava* coated catheter had the lowest inhibitory effect at 5.0, 10.0 and 20.0 mg mL^{-1}, with bacterial count ranging between 4.3×10^5-1.9×10^3 and 7.7×10^5-3.8×10^5 for 120 and 128 h, respectively. Despite the antimicrobial activities, the differences in the activity of these plant extracts were statistically not significant ($p<0.05$).

Key words: *Psidium guajava*, *Mangifera indica*, *Ocimum gratissimum*, *E. coli* biofilm, catheters

INTRODUCTION

Urinary catheterization has been an age-long process devised due to the emergence of medical conditions such as inability to store urine or the inability to pass out urine (Niel-Weise and van den Broek, 2005). Urinary catheters are inserted into the bladder either through the urethral (transurethral) or the anterior abdominal walls (suprapubic) (Getliffe, 2007; Tenke *et al*., 2008; Geng *et al*., 2012). The duration of catheter use differs from patient to patient, as it depends on how severe their condition occurs. Some patients may use catheters for 14 days or less (short term catheterization) while others could extend its use for about 30 days or more (long term catheterization) (Getliffe, 2007; Tenke *et al*., 2008; Geng *et al*., 2012). The use of catheter has helped immensely to keep the bladder functional in medically indisposed patients. However, catheter insertion has been a major concern because of its tendency to harbor harmful microorganisms including *Escherichia coli*, *Staphylococcus aureus*, *Proteus*, *Klebsiella*, *Enterobacter* and *Pseudomonas* species. *Candida* species are also involved in biofilm formation on catheter surfaces (Vlamakis, 2011).

Biofilms are formed when organisms adhere to catheter surfaces using flagella and other motility appendages. The organisms adapt to this new environment, grow and increase their population to become a sessile community. The community enlarges and become diversified through cooperation and quorum sensing (Trautner and Darouiche, 2004; Dwyer, 2008; Francolini and Donelli, 2010). Biofilms can colonize a whole catheter and move along the internal lumens of catheters into the bladder, kidney and sometimes the blood stream. This poses a public health problem for patients who depend on urinary catheters. Some of the nosocomial urinary tract infections that could arise due to catheters include