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Synthesis and Characterization of Alum Films

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Abstract

One of the biggest factors limiting the use of orthopaedic implants in humans is the bacterial invasion and bio-film formation on the surface of the implants. Number of patients with infection continuously increases as the number of patients requiring such implants grows. Thus, the aim of our study is to identify the antibiofilm activity of potash alum by inducing infection of *S. aureus.* The films were tested for antibiofilm property using biofilm assay on clinically isolated *S.aureus.* Biofilm formation has been induced when we used alum and methylcellulose combination. But the biofilm has been reduced when we used alum without methylcellulose.

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Keywords: Alum;Biofilm; Methyl cellulose;Stainless steel;*S.aureu.*

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1. Introduction

There are many orthopaedic device related infections (ODRI) *S.aureus* infection is the leading [1, 2]. Here, we are going to identify the antimicrobial activity of potash alum against *S.aureus.* The orthopaedic implants are removed or treated with antimicrobial agent by surgery, this causes discomfort and pain to the patients. To avoid this we have made antimicrobial films on implants. Potassium aluminium sulphate has good antimicrobial activity [3]. It has been used widely in ancient times, to clean the wounds and to stop bleeding in *Menorrhagia* patients. It is used as an after shave in barber shops and in deodorants due to its antiperspirant and antibacterial properties. It is soluble in water and it is colourless. Because of its antimicrobial property and its inexpensive and non toxicity, alum films were deposited to find applications in various aspects and fields of science. Alum can also be used as a mouthwash, studies proves that the reduction of salivary *Streptococcus mutants* [5]. A comparative study was conducted to prove the antifungal activity of alum [6].

Dip coating method is implemented to coat the films [4]. Among which dip coating through device mediated procedure is found to be efficient because of its controlled dipping speed and withdrawal speed. This gave us a uniform thickness in all the films. Potash alum solution when left for few hours it gets recrystallized. To stop this recrystallization and to increase the viscosity of the solution we have added methyl cellulose. Thus formed solution with methylcellulose is then coated over the stainless steel substrate using dip coating device by changing the parameters such as rpm, time and concentrations of alum. In the present work, we studied the anti-biofilm property of the potash alum films against different strains of *S.aureus* and their application in ODRI.

2. Experimental Details

Alum doped methyl cellulose films were deposited on stainless steel substrate (AISI 304), using dip coating method. The substrateswere rinsed with ethanol followed by double distilled water and acetone ultrasonication and then dried in air. Stock solution is prepared in 10ml of distilled water with 0.3g of alum and 0.25 g of methyl cellulose. 0.3 g of alum is dissolved first in 10ml of distilled water and vortexed or ultrasonicated. To dissolve methyl cellulose, the powder is mixed in hot water so that the methyl cellulose particles are well dispersed (and so have a much higher effective surface area) in the water and cool down this dispersion while stirring, leading to the much more rapid dissolution of those particles. The films were optimized by using different concentration of alum and Methyl cellulose. The substrate is then clamped in the dip coating device, which operates with the help of microcontroller. The films were prepared with different dipping time.

Micro-structural and morphological properties of alum with methyl cellulose films were studied using X-ray diffraction (XRD) and field emission-scanning electron microscopy (FE-SEM). The antibacterial property of alum is checked using QSL-2040 *S.aureus.* The minimum inhibitory concentration and minimum bactericidal concentration were studied. Luria Bertani broth (2.5g) is used in 24h culture of QSL-2040 (*S. aureus*). The MIC graph is plotted using the 18^{th} hour reading. The stock solution we have used is 0.1g of alum. After the serial dilution each concentration of solution is added to the petri plates where the bacterial culture has been streaked. The petri plates are incubated for 24 h at 37°C and then the colony forming units (CFU) were calculated. The minimum biofilm inhibition concentration was also studied. Two strains of *S. aureus* were taken into consideration *Sar* mutant and clinically isolated QSL-2040.

3. Result and Discussion

The concentration of alum and methyl cellulose should be optimized. Initially, we tried heating alum in a stainless