CHAPTER I

INTRODUCTION

The growth of microbes on textiles during use and storage negatively affects the wearer as well as the textile itself. The detrimental effects can be controlled by durable antimicrobial finishing of the textile using broad-spectrum biocides or by incorporating the biocide into synthetic fibers during extrusion. Consumers' attitude towards hygiene and active lifestyle has created a rapidly increasing market for antimicrobial textiles, which in turn has stimulated intensive research and development. The most recent developments in antimicrobial treatments of textiles using various active agents such as silver, quaternary ammonium salts, polyhexamethylene biguanide, triclosan, chitosan and dyes.

Chitosan, a deacetylated derivative of chitin, is natural, low-toxic, and resistant to microbial growth. An antimicrobial activity of chitosan is well-known which involves with the polycationic nature of chitosan capable of binding with anionic sites in microbe's proteins. However, its cationic nature is governed by acidic condition that limits this activity performance. In addition, chitosan inhibition of bacterial and fungal growth depends on the molecular weight and functional groups of chitosan. When compared to the high Mw chitosan, oligomeric chitosan can penetrate into cell membrane of a microorganism and prevents the growth of the cell by inhibiting RNA transcription. For applicability point of view as well as its antimicrobial capability, chitosan's solubility in water is important. To achieve this property, chitosan derivatives soluble in water over a wide pH range were prepared by introducing a quaternary ammonium group or polymeric quaternary ammonium moiety into chitosan side chain. For example, chemical modifications of chitosan by these means produce chitosan derivatives such as N-[(2-hydroxy-3-trimethylammonium)propyl] chitosan chloride which exhibits an enhanced antimicrobial activity [1] or polyethyleneimine grafted chitosan [2], trimethylated chitosan [3] which show an transfection efficiency.

Recently, hyperbranched polyamidoamine (PAMAM), a dendrimer analogue which is the starburst polymers with a plurality of terminal functional groups, has attracted considerable interest due to its novel functionalities such as nanoscopic containers [4] gene therapy [5] and ultrafine colloid stabilizer [6]. Modification of terminal groups with different functionalities such as acetamid, hydroxyl, carboxyl or quaternary ammonium further leads to the versatile applicability of these materials [7]. For example, it was reported that quaternized PAMAM dendrimers have been found to be potent antimicrobial activity [8]. In the other aspect, 'dendrimer–like' hyperbranched polyamidoamine could be incorporated into silica [9] or chitosan powder surface [10], resulting in hybrid materials with versatile functionalities.

Scope of this research

In this work, cationic hyperbranched dendritic polyamidoamine (PAMAM) was synthesized to use as an antimicrobial agent. Firstly, hyperbranched dendritic PAMAM was synthesized according to Tomalia's well known method by repetitive reactions between Michael addition and amidation. Then, quaternization of methyl ester terminated hyperbranched dendritic PAMAM by methylation with dimethyl sulphate was then carried out to obtain cationic hyperbranched dendritic PAMAM.

Moreover, grafting of cationic hyperbranched dendritic PAMAM onto chitosan was presented, aiming at the preparation of modified chitosan having good water solubility over a wide pH range and enhanced antimicrobial activity. Coating of bulk chitosan and in-situ depolymerization of coated chitosan on cotton fabric was carried out to study the antimicrobial activity and its depolymerization effect.

Finally, Treatment of cationic hyperbranched dendritic PAMAM and combined treatment of cotton fabric with chitosan and cationic hyperbranched dendritic polyamidoamine was investigated and the antimicrobial efficiency was evaluated.