ABSTRACT

Textiles are one of the most delicate artefacts in the world and can be easily damaged and deteriorate making them difficult to preserve, especially in tropical countries like India where the temperature and humidity is relatively high. They undergo physical, chemical and biological deterioration and cause damages to the textiles that are irreversible. As natural textiles such as cotton, linen, jute, leather, silk, wool and many more are composed of cellulose and protein, they provide a welcoming habitat for microbes to grow, leading to biological deterioration. Microbes, molds and insects can cause a decrease in strength, size alteration, the fabric becoming more hygroscopic, etching of inorganic materials with fungal acids, rotting of wooden shelves or cupboards, foul smells, discoloration, and the forming of holes.

Traditionally practiced preservative techniques in India for protecting textiles is to put them with herbs and spices such as cloves, cinnamon, camphor, Neem leaves, tobacco leaves, tulsi, lavender, citronella, eucalyptus and many more. These dry herbs and spices are placed in small bags around the shelves or boxes that store the fabrics. They contain compounds that can repel insects and kill bacteria, such as eugenol from cloves, monoterpenes from camphor, nicotinic acid from tobacco leaves, phenolic compounds from lavender oil, and carvacrol (a phenolic monoterpenoid) from oregano. It is believed that the vapors of these plants are toxic to insects and are thus able to keep them away. The use of a combination of herbs and spices has been found to be effective against certain bacteria. However, an issue with simply placing a mixture of these ingredients on a shelf is that it is not effective over a wide area. Furthermore, the active compounds in herbs and spices are typically vulnerable to light, meaning that they cannot be used directly on fabrics or surfaces.

In order to tackle these difficulties, the researcher has utilized essential oils such as neem, clove, cinnamon, and carom oil to create nanoparticles using chitosan as a polymer. This helps to make the oils more stable and provides biocidal and insect repellent properties to the textiles. The essential oils, which are the core component of the capsules, diffuse through the chitosan polymer shell, allowing a regulated release of the active compounds and providing long-lasting protection to the textiles against bacteria, fungi, and insects. The polymer shell also helps to prevent the active compound from oxidation and UV degradation.

To complete all the objectives, an extensive review and a survey were conducted at several textile museums and with individuals who are textile enthusiastic with their personal textile collection to understand the preservative practices used for the textiles. Later, an experimental approach was taken to understand the microflora environment of a preserved cellulosic and proteinic natured textile, isolation and identification of the microbes on a preserved cotton, wool, and silk fabric was performed. Finally, a finish was developed using different types of a two-step process, consisting of the microemulsion and ionic gelation method and emulsion and ionic gelation method to develop nano particles which were coated on to two subtrates: cotton and polyster fabric with the help of a binder using a pad dry cure method.

The characterization in terms of entrapment efficiency, loading capacity, size, polydispersity index, and surface analysis of the nanoparticles was performed. The nanoparticles after being coated on the fabric were tested for its antibacterial and antifungal properties. Further the treated fabric was also tested for its physicochemical stability of the nanoparticles over time and storage. Energy Dispersive X-ray test and insect repellency test was also performed against the treated fabrics. All the tests were performed using standard protocols.

The results revelad that the nanoparticles posses good antibacterial and insect repellent property and somewhat repellency towards fungi and it can be coated on a cotton fabric. The developed nanoparticle coated fabric can thus be used to cover the heritage textiles when in storage, as a lining for flat storage, and as padding on hangers and rollers, thus avoiding direct application to the antique textiles and causing them stress. Furthermore, it can also be used as a backing or covering material for exhibits. Thus, slowing down the degradation processes and limiting further aging of museum textiles while preserving as much as possible their unique characteristics for now and future generations.