ABSTRACT

In the modern era, consumer's attitude towards active healthcare and hygiene has created an increasing demand for the textile fabric functionalised with antibacterial properties. Textile fabric plays an important role in acquisition and transmission of pathogens in the hospitals as well as domestic use. Textile have long been recognised as media to support the growth of bacteria and fungi as it acts as a source of nutrients as well as shelter for bacteria. The growth of microbes on textiles during use and storage negatively affects the wearer as well as the textile itself. For these reasons, it is highly desirable that the growth of microbes on textiles be minimized by use of durable antibacterial textiles by incorporating the antibacterial agent into synthetic fibres during fibre formation. Out of many antibacterial agents, silver is one of the most widely used antibacterial agents since the evolution of the mankind. It is known that silver is one of the safest antibacterial agents as compared to organic compounds. Silver has been medically proven to kill over 650 disease-causing organisms.

While most of the research efforts have revolved around application of silver nanoparticles on textile substrates through finishing route, only limited efforts have been made to incorporate silver nanoparticles in fibres at melt spinning stage. Besides, most of the studies on antibacterial nanocomposite fibres are limited to fibre development and their characterisation only. It has been known that incorporation of silver nanoparticles in the fibres during the melt spinning stage leads to formation of fibres with much more durable antibacterial activity as compared to those where silver is applied topically through finishing route.

There is a void in development of antibacterial fabrics (woven or knitted) using fibres embedded with silver nanoparticles (nanocomposite fibres) and understanding the role of yarn and fabric parameters on antibacterial activity. Thus, in this research work, an attempt has been made to impart antibacterial functionality to woven and knitted polyester fabrics by blending

normal polyester fibres with polyester-silver nanocomposite fibres at various blend proportions and to study the effect of yarn and fabric construction parameters on antibacterial efficacy of such fabrics. It has been observed that woven and knitted fabrics prepared by polyester yarns containing small proportion (10-30%) of polyester-silver nanocomposite fibres demonstrate very good (63.20-98.89%) antibacterial activity against both Gram-positive (*S. aureus*) and Gram-negative (*E. coli*) bacteria. Blend proportion of nanocomposite fibres is found to be the most dominant factor in influencing the antibacterial activity of woven and knitted fabrics.

For healthcare applications, it is important to know the exact antibacterial activity of the textile materials. As this activity depends on various factors, it becomes an arduous task to predict its value in advance before the manufacturing of textile materials. For this reason, modelling, and prediction of antibacterial properties of knitted fabrics has been carried out using soft computing techniques such as ANN and ANFIS. The optimisation of the antibacterial and comfort properties of knitted fabric has been evaluated using desirability function. Further, some selected woven fabrics have been evaluated for antibacterial activity against multivariate bacteria. All these fabric show more than 93% antibacterial activity against multivariate bacteria. Further, 100% polyester woven samples which exhibited very good antibacterial activity were dyed with shade depth of 0.5% and 2.5% with a disperse dye. The effect of dyeing of woven fabrics on their antibacterial properties was determined. It was observed that the dyeing performance of polyester fabrics containing polyester-silver nanocomposite fibres in terms of K/S value was almost similar to neat polyester fabric. The wash and light fastness of such fabrics was very good and comparable to neat polyester fabrics. After dyeing, a marginal reduction (<2%) in antibacterial activity was noticed.