ABSTRACT

Silk is a type of fabric of natural origin. Silk is the protein fiber produced by silkworms for spinning the cocoon. Silk's incorporation into the textile industry can be attributed to its natural lustre, pliability, eco-friendliness, and mechanical strength. Silk culture is a traditional cottage industry rooted in the life and culture of Assam. Sericulture in Assam comprises *Pat* (mulberry), *Eri*, and *Muga* (all non-mulberry). Natural products with exceptional biological properties, especially antioxidant, antibacterial, biocompatible, and degradable in nature, are gaining widespread fame to be utilized in all walks of life. The research focuses on:

Washing, comprising of *Eri, Muga* and *Pat* wash through the washing agents available commercially and also the agents that are being used traditionally. The results of each wash by the agents were compared on the basis of the colour change. The change in color was found using ImageJ software, from where the hue, saturation, luminosity, and hex code were generated. The color deviation from the original silk fabric has also been calculated to check the difference and compare the washing agents. Along with the color change, Microscope and Scanning Electron microscope (SEM) images were also studied to check the fiber level damage caused by the washing agents. The Fourier Transform Infrared Spectroscopy (FTIR) of the washed samples was studied to check the attacking sites by the washing agents and the secondary protein transformation caused by them in the protein of silk fabric. The agents with less damage or deviations comparing all these parameters were considered to be better washing agents and can be suggested for washing.

Dyeing, here, curcumin, a natural dye that is also used as medicine and spice, has been used. Synthetic dyes were known to cause serious health hazards like allergies, carcinogenicity, and skin diseases, and hence, a natural dye that has medicinal value has been used. The use of silk in drug delivery or wound healing has already been in use, so, curcumin was also selected in a way to study the interaction of curcumin and silk for future possible stature or in wound healing. The low colourfastness of curcumin, as highlighted in many studies, was focussed, and tannic acid, a naturally occurring mordant with medicinal values, has been used for mordanting silk. The FTIR of different combination sequences of dye and mordant of the three silks were also studied to know

the binding sites as well as to have a possible mechanism of interaction during the different combinations of dyeing. The colorfastness of silk dyed with different combinations of dye and mordant has been carried out against light and wash. Colorfastness was studied on the basis of the color deviation of each cycle of light and wash. Since both curcumin and tannic acid are known to have antioxidant properties, the efficiency of different combinations of dye and mordant along with antioxidants was studied. The enhancement of untreated silk with the addition of dye and mordant has been compared. Antioxidant activity is one of the most important properties of bioactive fabrics, and radical scavenging fabrics can deactivate highly reactive and harmful species such as active oxygen radicals; hence, having antioxidant properties is an important factor.

Biocompatibility, as materials in contact with blood, must not induce thrombosis, thromboembolisms, antigenic responses, or the destruction of blood constituents and plasma proteins; thus, it is important to be biocompatible. Biocompatible, especially with blood, is the most important property with regard to biomedical materials; hence, the *Eri*, *Muga*, and *Pat* silk fabrics were subjected to a hemolytic test.

Biodegradation, the natural degradation of fabrics in soil is important as a control for pollution. Silk biodegradation had different results in the literature, and hence, a four-month soil burial method has been used to check the degradability of *Eri, Muga*, and *Pat* fabrics. Biodegradation is mainly evaluated via visual observation, determination of mass loss, and characterizing the chemical structure and surface morphology. Scanned microscopic images for visual observation, weight loss percent for measuring mass loss, FTIR for characterizing the chemical structure, and SEM imaging for surface morphology have been carried out.

Antibacterial, as tannic acid and curcumin were reported earlier to have antibacterial effects, the antibacterial role when linked with *Eri, Muga,* and *Pat* has been studied. Gram-positive bacteria *Staphylococcus aureus* and gram-negative bacteria *Klebsiella pneumonia* were used to check the antibacterial effect of silk dyed and mordanted with curcumin and tannic acid. The comparison has been carried out on the basis of bacterial reduction.

Application of the outcome of the studies has been done. Silk based filtration method proposed earlier was prepared for the combinations that showed better

antibacterial properties. Since *Kolakhar* showed better results for washing *Muga,* a thorough study on *Kolakhar* has been done, and on that basis, the active component of *Kolakhar,* activated charcoal, was used as a possible washing agent for *Muga*. The SEM, FTIR, and color analysis were carried out for activated Charcoal and compared with the earlier results of washing. Due to the appearance of shine in *Muga* silk, the glossiness of the silk fabric has also been studied.

Safe silk washing is an issue faced by its users for a long time because silk is prone to getting damaged during conventional washing. The current study focused on the possible *Eri, Muga*, and *Pat* silk fabric washing formulation, which was a rare event until people realized the importance of cleaning and hygiene with the onset of the covid-19 pandemic. Being pricey, the washing method plays a vital role in retaining the look of silk without compromising the fiber's quality. Silk fabric is in the sight of the textile industry for eco-friendly yard goods. Value addition to this natural and ethnic silk fiber is important as it will improve the livelihood of cultivators, and also, being animal protein has potential biomedical material. So, a lab-scale study has been performed for dyeing the silk as well as to check its antioxidant, antibacterial, biocompatibility and biodegradation properties.